Engineering Library

SEP 12 1932

ELECTRICAL WORLD

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SEPTEMBER 10, 1932
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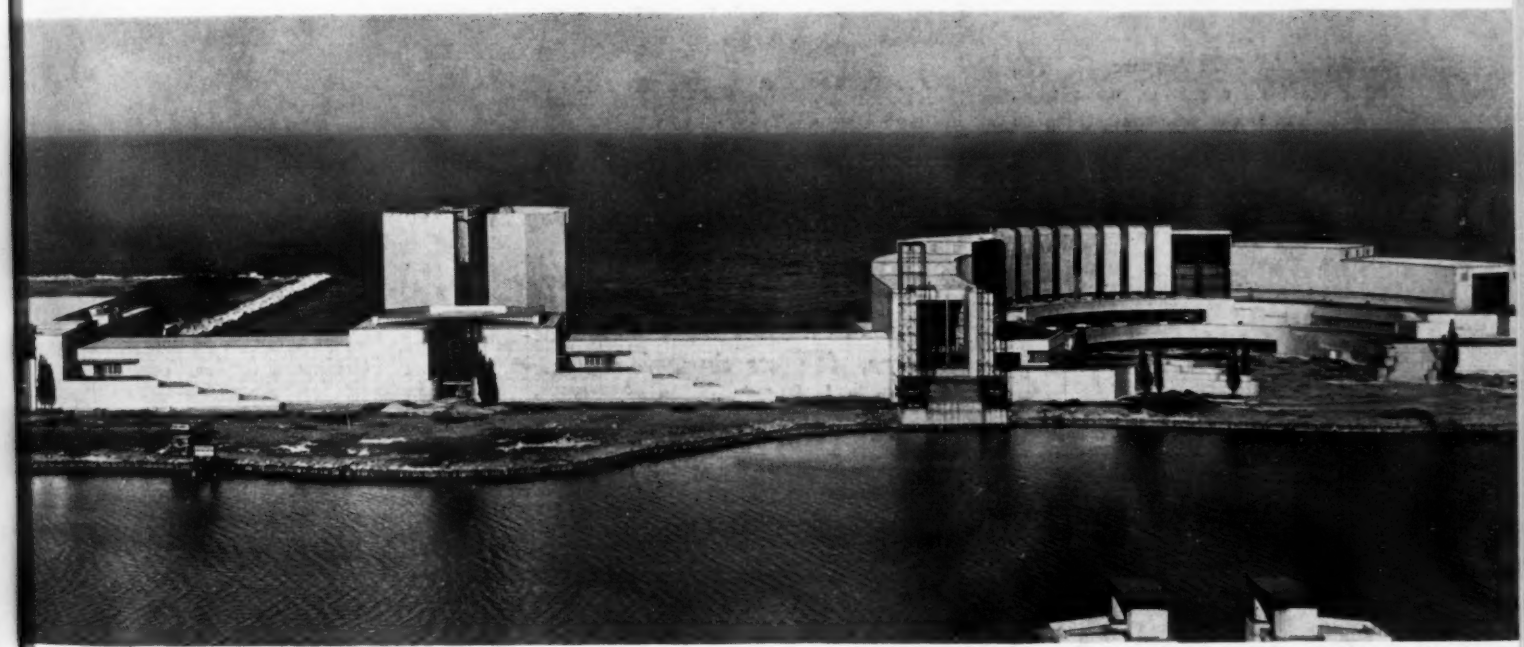


Electrical group of buildings for 1933 Chicago Century of Progress Exposition—*Wide World Pho*

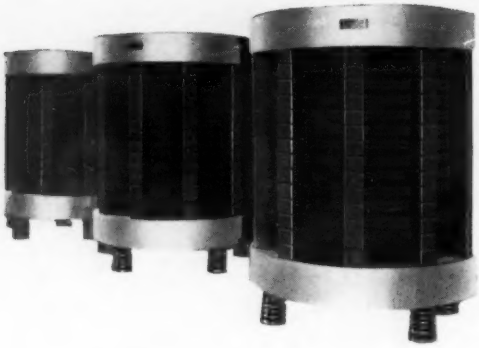
Engineers Help Develop Business — How men released from usual duties helped increase lighting business 100% in six months, harmonize sales cost with business acquired, smooth out sales curve and aid trade cooperation.

Is Frequency Regulation Fundamental? — Is the tail wagging the dog? Need frequency tolerances be ultra narrow? The problem of tie-line loading. Making the best compromise between service reliability and economy.

Mechanical Design of Rural Lines — One company's viewpoint on securing the service reliability necessary to attract and hold rural service and doing so with the least expense consistent therewith and future growth.

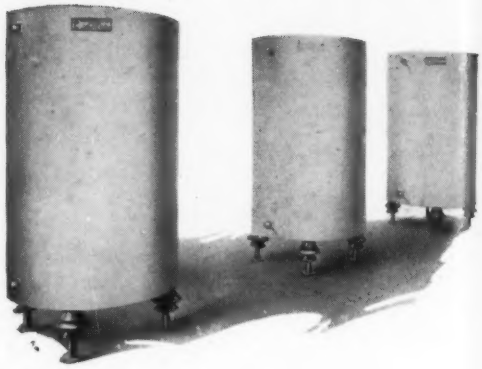
Carrier-current Relaying Effective — Necessity of clearing faults faster, regardless of nature and number of line sections, has led to development of simplified method avoiding high cost, and giving system planners more freedom in design. Field tests demonstrate practicality.

Balancing Power and Steam Output — A method used on the West Coast and which may be applicable wherever industrials tie in with utilities.



LEFT:

1336 K.V.A., 4060 Ampere, 11.4 K.V., 25 cycle indoor service, open type, fireproof construction.



ABOVE

277 K.V.A., 600 Ampere, 16 K.V., 50 cycle outdoor service, dry type, all enclosed reactors.

MURRAY Low Loss* Reactors

Reactors are supplied for all kinds of services.

Dry type reactors for line voltages up to 33 K.V. for indoor or outdoor installation, — as large as 5000 amperes, as small as .4 K.V.A.

Special reactors for testing purposes, for starting, for transformer balancing, or shunt reactors are also made.

When in need of reactor protection send us your inquiries. Efficiencies guaranteed.

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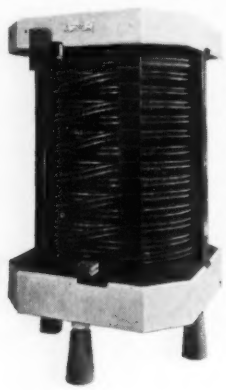
BELOW

1125 K.V.A., 3000 Ampere, 12 K.V., 60 cycle indoor service, open type, fireproof construction, special design to meet customer's space allotment.



ABOVE

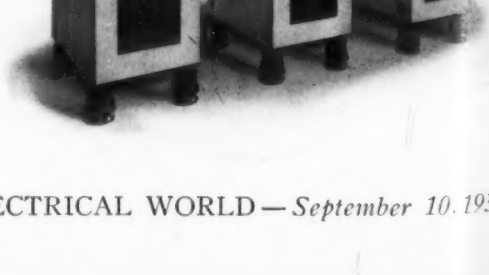
Special fuse testing reactor. Maximum short time rating 3000 Ampere, 12 K.V., 60 cycle, 6 tap variable reactance.

BELOW

36 K.V.A., 100 Ampere, 4.15 K.V., 60 cycle, 3 phase indoor service, enclosed type, fireproof construction.

RIGHT

162 K.V.A., 500 Ampere, 6.6 K.V., 25 cycle indoor service, enclosed type, fireproof construction.



ELECTRICAL WORLD

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for the Week Ending

September 10, 1932

New York and Detroit Celebrations Mark Industry's 50th Anniversary

LAST Sunday the electric light and power industry celebrated its 50th anniversary, for it was on September 4, 1882, at 3 p.m., that Thomas A. Edison's Pearl Street station began commercial operation supplying light to the offices of Drexel, Morgan & Company. He had in effect contracts for service with 59 customers, provided with a total load of 400 lamps. On September 4, 1932, a little band of noted industry leaders gathered before the old 257 Pearl Street building—now prosaically serving as offices for Magnus, Maybee & Reynard, purveyors of oils, essences, chemicals and drugs—as the $13,000,000,000 industry founded on Edison's courageous venture carried service to 24,000,000 customers in this country alone.

A bronze plaque, first dedicated in 1917, was rededicated as eleven Edison pioneers stood with other industry leaders on the street and sidewalk under the elevated railway. The ceremony was brief. President Frank W. Smith of the New York Edison Company system; Charles Edison, son of the inventor, and Henry A. Campbell spoke, the latter being one of the four survivors of the little group of men who were present when Pearl Street started.

F. W. Smith said in part: "Let us remember that Edison and his associates had no precedent to go by. There were boats before steamships, wagons and trucks before automobiles and kites and balloons before airplanes, but there was no forerunner of the Edison electric system. Everything had to be designed and specially built for it from the bottom up—not only the power house equipment, but the entire underground system of feeders, mains and service cutouts, together with lamp sockets, switches, fuses, fixtures and meters. The cap of a kerosene oil can suggested to Edison the screw base for the incandescent lamp, now the standard of the world. Some of these devices were crude at first, but they worked."

In Detroit the only Jumbo generator existent, No. 9, which survived a disastrous fire at Pearl Street many years ago and today stands in Henry Ford's Dearborn Museum, was once more placed in operation by President Alex Dow of the Detroit Edison Company. Mr. Dow, given a special steam engineering license, adjusted the valves which set old No. 9 to humming once more.

This Week

Adequacy wiring standards adopted by joint industry conference p. 327

Power use soars in New York during the eclipse p. 326

Ex-Commissioner Ainey of Pennsylvania dies p. 323

New Zealand hydro plant proves $9,000,000 failure p. 324

Hydro generation problems and costs at A. I. E. E. coast meeting p. 323

Westinghouse to promote new meter sales plan p. 329

Pennsylvania Electric Company bonds again banned p. 322

Jumbo Rolls Again

Just as 50 years ago a little group stood and watched the armatures begin to roll as steam entered the engine cylinders and saw the carbon-filament lamps turn from blackness to a ruddy glow and then to incandescence in the Pearl Street station in New York, so in Detroit another group gathered under a temporary shelter in Henry Ford's Greenfield Village to see the single survivor of Pearl Street's six "Jumbo" dynamos pick up speed and light a bank of those same carbon-filament lamps. On the latter occasion the hero of the piece was absent, but those gathered there to do him honor were lacking in imagination indeed if they did not feel he must be near.

The dynamo, restored and reconditioned, was coupled to one of the original Armington & Sims engines, possibly the same engine that drove this generator in the first electric central station. At a telephone signal from Henry Ford at his summer home, Alex Dow, president of the Detroit Edison Company, opened the throttle. As the unit came up to speed, George Cato, an associate of Ford in his power house days, lowered the brushes on the commutator and the old machine was working again. Speaking of the Pearl Street station in a short talk before he began his duty as chief engineer, Mr. Dow said that Edison, when he built the father of all central stations, did more than open the way to a new era so that others might take the direction he had shown; he built the era himself with his inventions for the practical commercial application of the product of his genius. Following Mr. Dow, Francis Jehl, an associate of Edison in those

early days, told of the difficulties that had to be overcome and the problems that had to be solved in putting Pearl Street to work. To James W. Bishop, an Edison Pioneer and right hand of Henry Ford in the collection and preservation of the beginning forms of the electrical age, goes the credit that Jumbo rolled again after 50 years.

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Holston River Power Applies for License

Application to the Federal Power Commission by the Holston River Power Company for a major project license, pursuant to a preliminary permit, has been made.

A power project involving four dams with an installed capacity of 124,500 hp. is contemplated. The company expects the electrochemical and other industries located within the area in Tennessee to use the power.

The project provides for four dams in the South Fork of the Holston River. Dam No. 1 would be 86 feet high, located 4½ miles above Kingsport; Dam No. 2, 140 feet high, about 1⅛ miles below the confluence of the South Fork and Watauga Rivers; Dam No. 3, 116 feet high, about 1¾ miles above Bluff City and Dam No. 4, 182 feet high, and located about one-third of a mile above the mouth of Riddle Creek and about 14½ miles upstream from Bluff City.

Reservoirs formed by dams 2 and 4 would be used chiefly for storage and the other two for daily regulation. The reservoirs above No. 2 would extend upstream to Dam No. 3 and about 15 miles up the Watauga River. The reservoir at Dam No. 4 would extend up the South Fork about 17 miles, the upper 4.4 miles in Virginia.

New Zealand Plant a $9,000,000 Failure

In spite of repeated restorative efforts the great 120,000-hp. Arapuni hydroelectric generating station of the New Zealand government appears to be headed, definitely, for the scrap heap. The recent collapse of the wall of the headrace at Arapuni, following the discovery that water had been seeping through the headrace lining, is the immediate cause for suspending operations once more.

For seven years Arapuni has been a history of repeated failures and disappointments. The present difficulties are the third in a series of major troubles. Originally planned for a $5,000,000 undertaking, before completion the job developed extreme hazards. It was started by a British engineering firm

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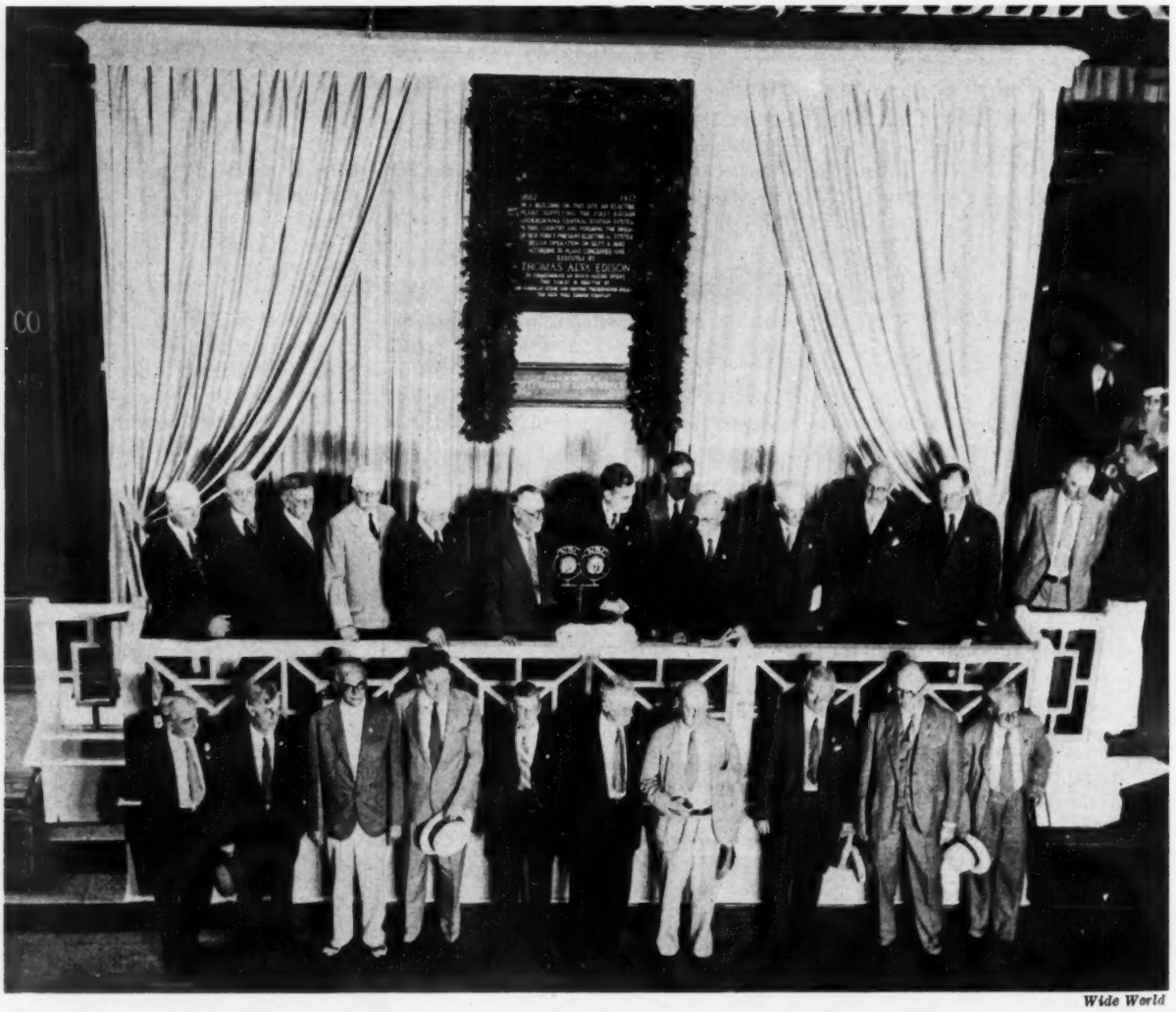
AT LIGHT AND POWER INDUSTRY'S 50TH BIRTHDAY



Wide World

Before the tablet set in the wall of 257 Pearl Street, New York, in 1917, Edison Pioneers and about 100 executives of the industry met last Sunday to observe the 50th anniversary of the opening for commercial operation of Edison's Pearl Street station. Here are pioneers and a few other guests. Charles Edison, son of the inventor, is behind the microphones. F. W. Smith, president of the New York Edison, is at his left and H. A. Campbell, one of the four men living who attended the Pearl Street opening, is at his right.

and completed by engineers of the Public Works Department. A steam station has been built to carry part of the load upon which Arapuni defaulted.

Geological troubles appear to have dominated the successive crises. "Trying to put a power unit on a rubbish heap" was the colorful comment of R. A. Semple, engineer and British member of Parliament, in his report concerning the country's inherent unsuitability for such a project.

New Zealand's power plan dates from 1910. Originally it was to have cost $36,000,000. To date $70,000,000 has been spent by the government and another $30,000,000 will probably be needed to see it through.

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Hydro Generation and Costs Tackled at A.I.E.E. Pacific Coast Meeting

HELD in the heart of a hydro-electric district of power generation, at Vancouver, B. C., the twenty-first annual Pacific Coast convention of the American Institute of Electrical Engineers appropriately undertook an analysis of the engineering problems of hydro and of the segregation of water-power costs.

E. E. Carpenter, consulting engineer, discussed the power system of the British Columbia Power Corporation, Ltd. Essentially a hydro system, problems encountered in the region served by it consist primarily of caring for a heavy precipitation having a rapid run-off due to the rugged topography and sparse vegetation in many of the watersheds. This difficulty is balanced by the natural reservoir sites carved by glacial action making stream regulation possible to a degree approaching their full economic limit. In contrast to this was a paper by G. C. Sears and A. P. Newberry covering the Rock Island development of the Puget Sound Power & Light Company and the difficulties incident to the construction work on a large stream subject to heavy flood periods.

W. S. McCrea, Jr., of the Washington Department of Public Works, suggested a method of analyzing and allocating the three elements, demand, energy costs and customers' cost, entering into hydro generation in his paper on "Segregation of Hydro Electric Costs." By a graphical and tabular presentation, a formula was developed for securing total yearly costs per kilowatt-hour for any load factor by evaluating proportional and fixed costs. Discussion brought out the fact that, while the analysis was intended primarily for rate structure calculations, there is a need for greater study of cost analysis procedure in the operating company.

The increasing importance of the electrical engineer in transportation fields was emphasized by two papers. One by G. R. Wright covered the details of the Reading Company's Philadelphia suburban electrification, showing how it has been possible to double train-miles and still effect a net saving over steam operation, the improved service resulting in greatly increased passenger traffic; J. B. Cox presented data on the electrical operation of the Great Northern Railway showing the savings and improved service gained from main line electrification. Engineering opinion expressed during the discussion indicated that this form of modernization by the railroads is an important means of recapturing lost traffic and placing those utilities on a more stable financial basis.

Further discussion of the factory-assembled idea for substation equipment was given by M. H. Hobbs of the Westinghouse Electric & Manufacturing Company. An important element developed both in this paper and in the ensuing discussion was the reduction in distribution costs which can be made by using factory-assembled substation units. These units are available for practically every type of service and the close scrutiny now being given plant costs and engineering economies will result in an increasing trend toward the use of this equipment. The dual need for increased circuit breaker interrupting capacities and for economies in securing them led to a coverage by R. E. Rowley, Department of Water and Power, City of Los Angeles, of the economics and methods involved in rebuilding existing breakers for heavier service. Discussion showed that many companies are investigating this means of strengthening power networks at nominal cost.

Investigations, made primarily to determine a feasible operating voltage for the future 300-mile transmission line between Hoover Dam and Los Angeles, by J. C. Carroll and B. Cozzens, cover corona problems on 220-kv. and 330-kv. lines. Washing cables before erection may, it was stated, be expected to lower corona losses. Measurements were made with extreme accuracy by means of a water column resistance wattmeter. Discussion brought out the desirability of making actual tests for corona losses rather than relying upon empirical formulas and indicated laboratories will be called upon to assist in solving many future design problems.

A practical method of setting up an equivalent circuit to ascertain the effects of triple harmonic voltages and currents in power circuits was presented by T. H. Morgan, Worcester Polytechnic Institute, and C. A. Barios and G. S. Kimball of Stanford University. Explanation was given to conditions which produce triple-frequency resonance and the resulting distortion of the line to neutral voltage if a resonant condition exists. Announcement of the development by the Pacific Electric Manufacturing Corporation of bushing type current transformers with essentially zero error, through an improved core design, was made by A. C. Schwager and V. A. Treat.

About 300 members, guests and students attended the meetings. President Charlesworth commended the sustained interest of the Pacific Coast group of A.I.E.E.

September Marked for Test of Business Resumption

UNDISMAYED by the failure of business itself to respond warmly to the powerful stimulants of credit availibility, organized propaganda in the form of highly magnified good news, security and commodity market upswings and the well-known ballyhoo, that large body of the public so ecstatically hopeful for the past few months apparently accepts September as the test period. Business will begin its comeback then, one hears, and the indexes, as yet recalcitrant to all importunities, will reflect the new state of mind. Be that as it may, there are but eight weeks before election day.

Two appreciable changes in the latest figures for basic indexes occurred this week. Energy production rose 2 per cent; car loadings gained nearly 4 per cent. Such improvements may or may not be significant now for fluctuations of this magnitude are to be expected and occur frequently. If sustained for three or four weeks a turn might reasonably be called.

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Ex-Commissioner Ainey of Pennsylvania Dies

William D. B. Ainey, who resigned not long ago as chairman of the Pennsylvania Public Service Commission under the fire of sensational charges brought against him by Governor Pinchot, died at his home in Harrisburg, Pa., last Sunday.

Mr. Ainey, long the dean of the regulatory group in the electrical industry, pleaded ill health and lack of funds to conduct a defense of his actions when attacked by Pinchot. His health, long failing, declined rapidly after he relinquished his duties as a commissioner.

Coming Meetings

Rocky Mountain Division, N.E.L.A.—Stanley Hotel, Estes Park, Colo., Sept. 12-14. G. E. Lewis, 367 Gas & Electric Bldg., Denver.

Empire State Gas and Electric Association—Saranac Inn, N. Y., Sept. 22 and 23. C. H. B. Chapin, Grand Central Terminal, New York.

Electrochemical Society — Cleveland, Ohio, Sept. 22-24. Colin G. Fink, Columbia University, New York.

National Electrical Manufacturers Association—Westchester Country Club, Rye, N. Y. Sept. 26-29. A. W. Berresford, 570 Lexington Ave., New York.

Illuminating Engineering Society—New Ocean House, Swampscott, Mass., Sept. 26-30. E. H. Hobbie, 29 W. 39th St., New York.

National Electrical Wholesalers Association—Hotel Statler, Buffalo, N. Y., Sept. 26-30. E. Donald Tolles, 165 Broadway, New York.

American Welding Society — Buffalo, N. Y., Oct. 3-7. M. M. Kelly, 29 West 39th St., New York.

National Electric Light Association—Engineering Committees meeting. Edgewater Beach Hotel, Chicago, Ill., Oct. 3-7. A. J. Marshall, 420 Lexington Ave., New York.

National Safety Council—Washington, D. C., Oct. 3-7. W. H. Cameron, 20 N. Wacker Drive, Chicago.

Association of Electragists International—Kansas City, Mo., Oct. 10-12. L. W. Davis, 420 Lexington Ave., New York.

American Institute of Electrical Engineers—Middle Eastern District Meeting, Baltimore, Md., Oct. 10-13. H. H. Henline, 33 West 39th St., New York.

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Commission Orders Service When Schedules Are Filed

Holding that a definite obligation rests on a public utility when it filed schedules providing for the manner in which rural extensions of electric lines shall be built and paid for, the New York Public Service Commission has directed the New York State Electric & Gas Corporation to furnish on and after January 1, 1933, electric service on rural lines to a large number of farmers who have made applications to the company for such service and complied with the terms and requirements of the company's filed schedules under which the company agrees to supply the public with electricity.

It is further directed that the company shall, upon written request of any prospective customer, provide such applicant with proper forms of applications for rural service. The company is likewise directed on or before October 1 next to notify the commission whether it will accept and carry out the terms of the order and to supply the commission with a plan in writing which will outline the order for furnishing the service to various persons who have made application for such service and who have done their part in complying with the legally filed schedules of the electric company.

The commission, on its own motion, began an investigation following the filing of about 50 informal complaints from prospective customers seeking extensions who, it is alleged, were unable to get service from the company. The corporation replied to these requests for service, indicating that it had no available funds with which to make the extensions. The company, in the proceedings before the commission, is alleged to have failed to prove lack of funds as an actual fact or to have withdrawn the schedules under which customers complied and asked for service. This utility recently filed a substitute schedule covering the line extensions under which extensions will be made provided a customer or customers furnished funds under an advance to the company of $1,600 per mile, refunds to be made to the customer or customers at the first of each year.

Company seeks financing right

When asked what action would be taken on the commission's order, officials of the company are reported to have said that while they were in full accord with the commission as to the desirability of extending service, in present conditions it was impossible to finance such extensions unless the commission allowed the increase in capitalization to which the corporation felt that it was entitled and for which applications were pending.

"Application for capitalization through which the company may reimburse itself for approximately $7,000,000 of construction have been pending before the commission for as long as five years," an officer of the system states. He added that if the company could be empowered to issue securities to provide this capitalization it would undertake a program of rural extension far greater in scope than that demanded by the commission in accordance with plans already laid out, but that the inability of the company to obtain short term loans now without securities to issue had virtually brought the program to a standstill.

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Third Suit Filed Against Louisville Utilities

Suit against the Louisville Hydro-Electric Company, involving a sum of $2,000,000, constitutes the third suit recently filed in Louisville against the Louisville Gas & Electric Company and its subsidiaries. This suit, naming T. Bert Wilson, president, who is also president of the Louisville Gas & Electric Company, is being brought by Sheriff Hubbard Petty, charging that for four years the company has failed to report its income to the state auditor, from which a fair valuation of franchise could be based. The petition claims that the franchise assessment on an estimate is $30,000,000 and asks the court to set it at that. The state collects 50 cents franchise tax and the county 40 cents, but the Petty suit is only for the county tax, which, with 6 per cent interest and 20 per cent penalty, would amount to about $2,000,000 on basis of estimate.

Previously Sheriff Petty had sued the Kentucky Coke Company, another subsidiary of the Louisville Gas & Electric Company, on a similar claim. Another suit was brought by M. J. Brennan, state Revenue Agent, for alleged failure to pay taxes on franchise values, etc. (ELECTRICAL WORLD, September 3, page 290.)

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Pennsylvania Electric Bonds Again Banned

Pennsylvania Securities Commission has issued another order forbidding the sale in Pennsylvania of Pennsylvania Electric Company first refunding mortgage bonds, series H, 5s, due 1962. This is the second order in a little more than a week issued by the commission against the bonds of that company. The first order was rescinded when evidence was produced to prove that proceeds of the bonds were not to be used in the purchase of the Clarion River Power Company, acquisition of which is now under attack by the Federal Power Commission and the Pennsylvania Public Service Commission. The new order, again prohibiting the sale of the securities, is based on information that earnings of the Pennsylvania Electric Company as set forth in a circular, both as originally submitted and as revised, were stated so as to include earnings of the Clarion River Power Company.

The Public Service Commission has started on its own motion to investigate the issue of these bonds, ordering its law bureau to institute suit to restrain the sale of these bonds and certain notes of the company in the state of Pennsylvania.

Clarion case to Supreme Court

The Clarion River Power Company has petitioned the Supreme Court of the United States to review the decision of the Court of Appeals of the District of Columbia, holding that the Federal Power Commission has the authority to determine at the present time the amount of investment in the company's Piney project on the Clarion River in Pennsylvania. The company, the petition explains, holds a 50-year license under the federal water-power act for the project which it has completed. It contends that the commission has no authority at this time to make any determination of the investment in the project, but that such determination must be made by a federal court in equity at the end of 20 or 50 years of operation under provisions of the water-power act. A résumé of the discussion between the company and the commis-

sion, including details of the decision handed down by the Court of Appeals of the District of Columbia, was published in the ELECTRICAL WORLD, June 4, 1932, page 972.

The Federal Power Commission has extended by ten days the time for the Clarion River Power Company and the Pennsylvania Electric Company to file a report on the alleged sale of the Clarion property to the Pennsylvania Electric Company.

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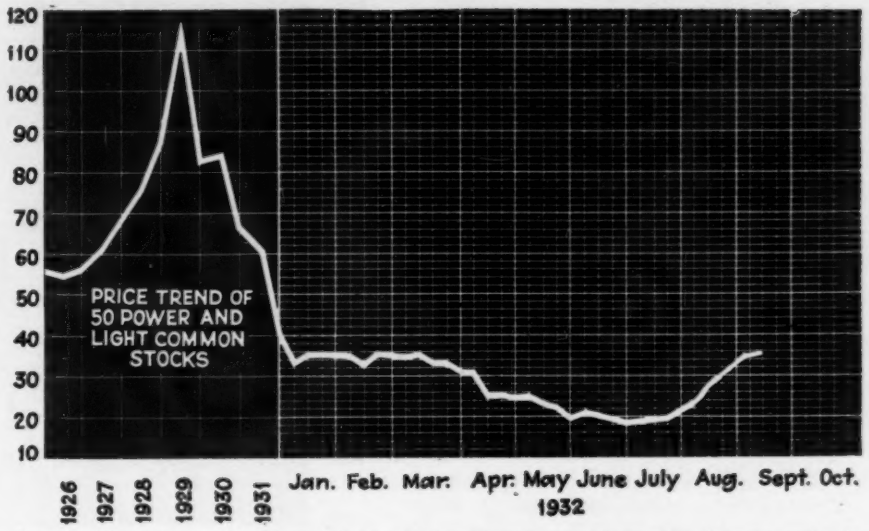
New England Power Reduces Loans

Bank loans of the New England Power Association and all subsidiaries now amount to $6,680,000, a 65 per cent reduction since the first of the year, according to a statement made by Archibald R. Graustein, chairman of the executive committee. "The association," he said, "is making progress on its plans to refinance the maturity of its $20,000,000 notes and the $7,500,000 North Boston Lighting Properties notes falling due in the latter part of this year."

Stocks Continue Upward Movement



Stocks listed on the New York Stock Exchange showed a larger gain in August than in any month in the past three years. In July and August the rise represented approximatly 80 per cent. "Electrical World" index was 36.0 this week.

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Current Earnings Reports of Electric Light and Power Companies

OPERATING COMPANIES

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
Alabama Power					
(Year ended June 30)					
Gross earnings	$16,730,797	$17,982,659	— 7.0	46	47
Net earnings	8,494,823	9,545,221	—11.0	..	..
Net profit	1,569,616	3,163,079	—50.4	..	..
Consumers Power					
(Year ended June 30)					
Gross earnings	29,073,611	31,671,822	— 8.2	47	52
Net earnings	14,216,000	15,253,298	— 6.8	..	..
Net profit	6,386,884	7,747,241	—17.6	..	..
Duquesne Light					
(Year ended June 30)					
Gross earnings	26,609,711	28,526,337	— 6.7	43	43
Net earnings	15,292,949	16,231,582	— 5.8	..	..
Net profit	11,587,669	13,224,037	12.4	..	..
Georgia Power*					
(Year ended June 30)					
Gross earnings	23,760,912	25,799,645	— 7.9	51	56
Net earnings	11,640,361	11,518,329	1.6	..	..
Net profit	2,647,936	3,176,750	—16.6	..	..
Kansas City Power & Light†					
(Year ended July 31)					
Gross earnings	14,700,445	14,864,434	— 1.1	59	60
Net earnings	5,970,681	5,909,803	1.0	..	..
Net profit	4,333,577	4,354,209	— 0.5	..	..
Northern States Power					
(Year ended June 30)					
Gross earnings	33,479,503	33,690,458	— 0.6	58	58
Net earnings	14,194,619	14,275,349	— 0.6	..	..
Net profit	3,351,873	3,786,437	—11.5	..	..
Puget Sound Power & Light					
(Year ended June 30)					
Gross earnings	14,718,411	16,524,491	—10.9	60	63
Net earnings	5,740,932	6,070,072	— 5.4	..	..
Net profit	745,895	671,435	11.0	..	..
Tennessee Electric Power					
(Year ended June 30)					
Gross earnings	12,850,755	14,023,216	— 8.4	58	61
Net earnings	5,410,418	5,433,833	— 0.4	..	..
Net profit	1,330,960	1,769,219	—24.9	..	..
Virginia Electric & Power					
(Year ended June 30)					
Gross earnings	16,304,570	17,073,852	— 4.5	66	67
Net earnings	5,585,073	5,650,626	— 1.2	..	..
Net profit	2,553,121	2,755,209	— 7.3	..	..

Gross earnings — Gross operating revenue. Net earnings — Earnings after deduction from gross earnings of operating expenses taken to include taxes, depreciation, maintenance, operating, etc. Net profit — Balance available from income for common stock dividends.

HOLDING COMPANIES

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
American Power & Light & subs.					
(Year ended June 30)					
Gross earnings	$79,056,609	$85,337,092	— 7.4	53	54
Net earnings	37,437,910	39,118,346	— 4.3	..	..
Net profit	15,045,418	18,498,770	—18.8	..	..
American Water Works & Electric & subs.					
(Year ended June 30)					
Gross earnings	47,013,932	52,252,703	—10.0	56	58
Net earnings	20,787,924	21,693,690	— 4.2	..	..
Net profit	4,227,447	4,756,328	—11.1	..	..
Associated Gas & Electric & subs;					
(Year ended July 31)					
Gross earnings	101,518,660	105,986,211	— 4.0	65	61
Net earnings	35,083,011	41,743,421	—16.0	..	..
Net profit	Not given	Not given	....	..	..
Columbia Gas & Electric & subs.					
(Year ended June 30)					
Gross earnings	82,722,893	93,429,817	—11.4	67	67
Net earnings	26,921,408	30,981,193	—13.1	..	..
Net profit	12,620,164	18,130,093	—30.4	..	..
Electric Power & Light & subs.					
(Year ended June 30)					
Gross earnings	75,930,973	83,597,850	— 9.2	56	57
Net earnings	33,049,258	36,122,724	— 8.5	..	..
Net profit	9,545,889	13,071,939	—27.1	..	..
Engineers Public Service & subs.					
(Year ended June 30)					
Gross earnings	48,282,269	52,743,090	— 8.5	65	66
Net earnings	17,154,487	17,776,224	— 3.5	..	..
Net profit	3,143,346	4,163,441	—24.6	..	..
National Power & Light & subs.					
(Year ended June 30)					
Gross earnings	74,556,525	78,823,375	— 5.4	60	62
Net earnings	29,923,618	29,976,010	— 0.2	..	..
Net profit	11,272,330	12,190,425	— 7.5	..	..
North American & subs.					
(Year ended June 30)					
Gross earnings	112,595,410	121,827,955	— 7.6	65	64
Net earnings	39,597,926	43,689,672	— 9.3	..	..
Net profit	19,557,331	24,365,006	—19.8	..	..
United Gas Improvement & subs.					
(Year ended June 30)					
Gross earnings	103,791,085	107,436,312	— 3.4	56	57
Net earnings	45,207,940	46,172,105	— 2.1	..	..
Net profit	32,796,354	35,356,097	— 7.2	..	..

* Balance available for second pfd. and common dividends.
† Balance available for preferred and common dividends.

Back-to-the-Farm Move Sponsored by Utilities

Executives of light and power companies have places of prominence on the Midwest Farm Committee, newly created organization of four states, formed to foster and facilitate a "back-to-the-farm" movement. Chambers of commerce in Missouri, Kansas, Oklahoma and Arkansas are co-operating in the enterprise. Unemployment relief and economic betterment are aims.

J. F. Porter, president Kansas City Power & Light Company, has been named as a Missouri representative; O. H. Weddle, district manager Kansas Electric Power Company, Emporia, and J. F. Owens, president Oklahoma Gas & Electric Company, Oklahoma City, are others selected from the industry. Improved living conditions on the farm and electricity's contribution thereto are stressed as factors favoring the movement. Large-scale advertising is being used. Services of the organization are entirely gratuitous.

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Chicago District Picking Up

During recent weeks electrical energy production in the Chicago district has been gaining somewhat compared with the country as a whole. It continues to be less than in the corresponding period last year, but the discrepancy has lately been diminishing. Percentages by which current output is lagging behind that of 1931 are as follows:

Week Ended	United States	Central Industrial Area	Chicago District
August 27	12.3	15.2	11.8
August 20	12.9	16.3	13.8
August 13	13.1	16.6	13.1
August 6	13.1	16.6	14.2

Commenting on the general improvement in percentages for the latest week, a report from the Commonwealth Edison Company lists three possible explanations: The average temperature was 5 deg. higher this year than last; there was a definite falling off in business at this time last year; there probably is some improvement in business this year, but one week's figures are not enough definitely to establish such a conclusion.

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Power Demand in New York Soars During Eclipse

Though in a region of but 95 per cent totality during the height of the eclipse last week, when the sunlight reaching the city decreased in the proportion of 60 to 1, the demand for electrical power in New York jumped to 20,000 kw. above the normal for that time of the day and year, which is around 750,000 kw. The moment of maximum obscuration was at 4:34, but the greatest demand came at 4:40 p.m., when, according to the New York Edison Company, the excess above normal rose to 50,000 kw. or more.

Edison engineers assume that at the darkest moment most citizens were outside of their homes and offices looking at the sun and that when they returned indoors and found it to be darker than it had seemed outside the power demand went up. This explanation was borne out by statements made by engineers of the Electrical Testing Laboratories, where the decrease in light was measured by a photometer.

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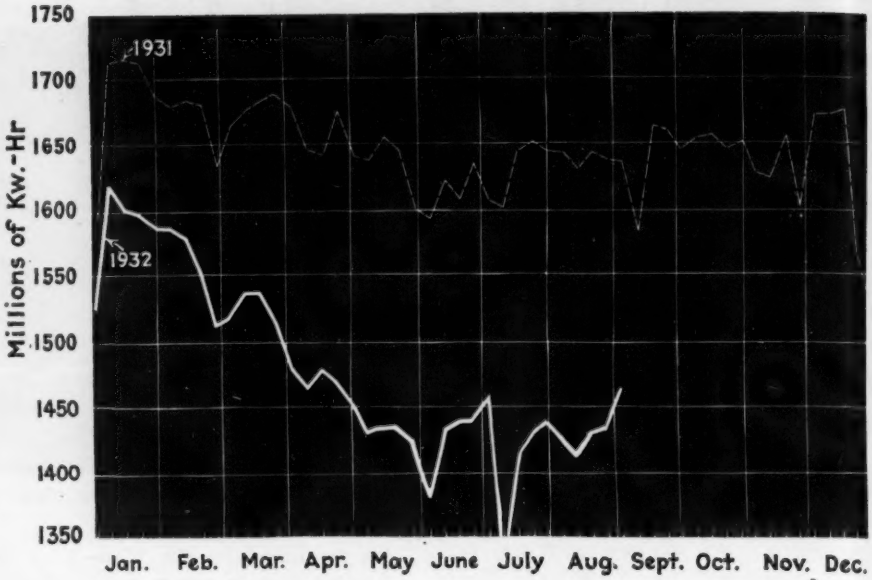
Central West Deposits Assure Refunding Plan

Reports indicate that 93 per cent of the holders of the matured 7 per cent three-year notes of the Central West Public Service Company have agreed to the exchange of these matured obligations for new 7 per cent three-year gold notes. This and the decision of the company to pay interest overdue on the three series of its first lien collateral bonds indicate a strong probability that the receivership applied for in Chancery Court, Wilmington, Del., on June 8 can be averted. The court has been holding its decision in abeyance pending the outcome of the exchange proposals.

Although deposits are swiftly approaching 100 per cent, the company has delayed declaring the plan of exchange operative in order to give the remaining holders an opportunity to participate in the offer. The closing date for exchange, originally set for September 15, has been postponed.

The next maturity of the company will come due on December 15 next, when $2,800,000 of series C first lien bonds will fall due. Payment of May 1 interest on its 6 per cent debentures and of its December 1 interest on these and its 5½ per cent first lien bonds remains a problem which is foreseen as greatly simplified by the success of the note exchange plan.

Output Increases 2 per Cent



FURTHER gain in central station energy production is indicated in the 1,464,700,000 kw.-hr. announced by the National Electric Light Association for the week ended September 3, against 1,436,440,000 kw.-hr. the week before. Since the middle of August the disparity compared with 1931 has decreased in successive weeks from 13.1 per cent to 12.9, 12.3 and now to 10.4 per cent.

Closer approach to 1931 figures is reported from every region. The greatest relative gain has been made on the Atlantic seaboard, down 10.1 per cent three weeks ago, now only 5.8 per cent. In New England alone the improvement was nearly as great. During the same period the disparity in the Central industrial area shrank from 16.6 to 13.6 per cent.

Weekly Output, Millions of Kw.-Hr.

Week Ended	1932	1931	1930	1929
September 3	1,465	1,636	1,630	1,675
August 27	1,436	1,638	1,688	1,762
August 20	1,432	1,643	1,691	1,750
August 13	1,415	1,629	1,677	1,733
August 6	1,427	1,643	1,692	1,730
July 30	1,440	1,644	1,678	1,725

Per Cent Change from 1931

Region	Week Ended Sept. 3	Aug. 27	Aug. 20
Atlantic Seaboard	— 5.8	— 8.2	— 8.8
New England alone	— 7.5	— 8.6	— 9.1
Central industrial	—13.6	—15.2	—16.3
Pacific Coast	—10.5	—11.9	—12.4
United States	—10.4	—12.3	—12.9

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Mississippi Power Dam Opposed in Missouri

Application for a preliminary permit for the construction of a power dam on the Mississippi River near the Chain of Rocks Bridge, St. Louis, Mo., is protested in a petition filed in the County Court of St. Charles County by 128 property owners.

Objectors to the project stated that back water from the dam would permanently cover 30,000 acres of land, and that in addition 60,000 to 90,000 acres of land would be affected by seep water. It was also stated that a great amount of taxable property would be lost to the county, and that the seep water would impair the health of the residents.

The County Court will file the petition and the list of objections with the Federal Power Commission.

The application for the power project stated that the proposed dam will be a constant overflow dam, and that it will develop 175,000 hp., which would be used to serve industries to be located near the site of the dam. The application was filed with the Federal Power Commission by Carl G. Stifel, a real estate man of St. Louis.

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Adequacy Wiring Standards of Joint Industry Conference

Recommended standards for electrical wiring in residences and apartments, long under discussion (ELECTRICAL WORLD, February 6, page 261) have at last been agreed upon by a joint industry conference of which E. A. Brand of the Buffalo, Niagara & Eastern Power Corporation is chairman. The standards are sponsored by the Artistic Lighting Equipment Association, Association of Electragists International, Illuminating Engineering Society, National Electric Light Association, National Electrical Manufacturers' Association, National Electrical Wholesalers' Association, Society for Electrical Development, Inc., and indorsed by the International Association of Electrical Inspectors.

The standards have been selected to assure a reasonable efficiency and convenience and to avoid the necessity for major changes in wiring capacity following the completion of the structure. The recommendations do not deal with installation methods or materials, but are confined to provisions for the number of outlets, their nature and control and the method of supplying service to them.

Reasonable provision for future development of electric household applications has been anticipated, it is claimed, in both the determination of wire sizes and the location of lighting and appliance outlets or connections. At the same time, consideration has been given to economy of installation by requiring a minimum number of branch circuits to provide adequate capacity.

These standards are offered as representing a standard of adequacy applicable on a national scale and without the detailed requirements sometimes dictated by local conditions. They are specifically mentioned, therefore, as not conflicting with local Red Seal standards. Full copies of the standards may be obtained from any of the eight sponsoring and indorsing bodies.

▼

Montreal Board Considers City-Owned Plant

The city of Montreal is again seriously considering constructing its own hydro-electric plant as a part of the aqueduct system. Figures on construction costs and estimates are being studied and experts have already predicted an annual saving of $300,000. The plan covers supply of power to run the pumps of the aqueduct, to illuminate city buildings and streets, but only in that area of Montreal covered by the conduit lighting system. In that area the city is proprietor of the conduits, and can therefore control power lines.

Belief is expressed that for $3,000,000 the hydro plant could be built. Against that is the annual bill of $750,000 which the city now pays to private enterprise for current and power. Before the project can be proceeded with, however, there will be a fight over claims of the Montreal Light, Heat & Power Consolidated to rights in the St. Lawrence River waters below the company's existing plant in the stream opposite Ville LaSalle, that claim covering the spot where the city's hydro spillway would empty into the river.

Should that obstacle be beyond removal, there is a proposal that the city should in any new contract it makes with private companies for light and power—and that contract is now pending—require a clause that in a stated period the way would be opened for the city to build its hydro plant and furnish power for the aqueduct pumps.

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Seattle Has Large Crane

Said to be the largest power crane ever built, a 300-ton, two-trolley traveling crane for use in the 83,000-hp. Skagit River power plant at Diablo Dam has just been shipped to the Department of Lighting, Seattle, Wash. Weighing approximately 392,800 lb., it is provided with seven motors. It was built by the Harnischfeger Corporation, Milwaukee, Wis.

Major New Construction This Week

HEAVY-DUTY MOTORS and controls, transformers, regulators, pumping machinery and conveyors will be installed by Sinclair Refining Company at Argentine and Coffeyville, Kan. A $2,000,000 expansion program.

Plans being completed and work soon begins by Potomac Electric Power Company, Washington, D. C., on a 35,000-kw. steam-electric generating plant in Buzzard's Point district, with provision for later expansion to 200,000-kw. capacity. Cost over $3,500,000 with transmission lines, etc.

Machine drives, motors and controls, transformers and accessories, etc., required for $200,000 dry ice manufacturing plant at Los Angeles, Calif., by Pacific Carbonic Ice Company, Orange, Calif..

Heavy-duty motors and controls, machine drives, regulators and auxiliary electrical equipment will be installed at Weirton, W. Va., mill of National Steel Corporation for a $700,000 expansion and improvement program.

Bond issue of $745,000 is being arranged by Fort Collins, Colo., for a city-owned electric light and power plant.

Machine drives, motors and controls, regulators, conveying and other electrical equipment will be installed in Corinth, N. Y., mill of International Paper Company. Expansion and improvement project to cost about $100,000.

Utility Must Pay for Line Extension

The cost of constructing a 2-mile extension of the Potomac Electric Power Company to supply current to the House of Reformation at Cheltenham will have to be assimilated by the company, the Public Service Commission of Maryland ruled last week. Under the ruling the company is ordered to complete the extension as soon as possible and also to base its charges on the low farm rate for light and power. The company had informed the applicant that the billing would be under the straight commercial rating and that the cost of the extension —$1,350—would have to be carried by the subscriber. The commission decreed that the business to be obtained by the company through the extension would amount to more than $600 and that it would also acquire ten other private subscribers along the route.

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New York Metal Prices

	Aug. 30, 1932 Cents per Pound	Sept. 6, 1932 Cents per Pound
Copper, electrolytic	5.50	6.00
Lead, Am. S. & R. price	3.60	3.60
Antimony	5.50	5.50
Nickel ingot	35.00	35.00
Zinc, spot	3.15	3.50
Tin, Straits	24.50	25.25
Aluminum, 99 per cent.	23.30	23.30

Insull Receivers' Pay Cut

"Hopeful that the services to be rendered in the future will be less arduous," Judge Lindley allowed compensation of $7,500 each to two receivers of Insull Utility Investments and equal amounts to the counsel of each for services from April 15 to September 15. The receivers had petitioned for $10,000. Judge Lindley also referred to the hope that the "estate be not exhausted by administrative expenses."

▼

Power District Foes Win Point

Opponents of the creation of a municipal power district in the city of Spokane won a point last week when Judge Huneke held the petitions for the district defective, enjoined the county commissioners from considering them further and enjoined the election board from placing the issue on the November ballot. The decision means an end to the city power proposal this year. The preceding week Judge Witt threw out the county power petition, holding that the petitions did not comply with the law.

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New Mexico Commission Expands

Enlarging its scope of regulatory activities to include the ginning of cotton the New Mexico Corporation Commission has set a precedent in rate regulation and jurisdiction. Owners now plan a battle denying cotton gins to be public utilities. Chairman H. H. Williams of the commission points out that in fifteen formal hearings, involving in one case or another all the 47 gins of the state, rates have been fixed and jurisdiction established, but that the present controversy arises over a rule designed to prevent rebate evasions of set rates.

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Swiss Railways to Expand

Further electrification of the Swiss railways during the next few years will necessitate construction of a new power station, plans for which are being made at present. This will be a hydro-electric plant with a reservoir, near Einsiedeln, about 5 miles long and a mile wide. Production of 110,000 hp. of single- and three-phase energy is planned.

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Preferred Stock Sold at Auction

Pursuant to order of the Massachusetts Department of Public Utilities dated May 6, 1932, 11,975 shares of New England Power Company 6 per cent cumulative preferred stock have been sold at auction at $100 a share in Boston. In May the company offered its preferred-share holders the right to subscribe for 12,000 additional shares at par, but in view of market conditions only 25 shares were taken. In accordance with Massachusetts law, all shares not taken by shareholders must be sold at public auction.

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No Atlantic City Referendum

The Atlantic City (N. J.) Commission has declined by resolution to authorize a referendum for municipal ownership of the local gas and electric plants. The commissioners denied the validity, legality or effectiveness of petitions urging a popular vote on the question. The resolution also pointed out that Atlantic City was not in a position to finance the acquisition of the two utilities.

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Unless we solve the problems of distribution, of mass purchasing power, then your efforts in improving engineering technique and devising means of increasing production will be doomed to fail.

DAVID E. LILIENTHAL,
Wisconsin Public Service Commissioner

[Mr. Lilienthal warned the National Association of Power Engineers, meeting in Milwaukee this week, of the probable end of another new era of 1929 origins.]

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Potomac Edison Valuation

Hearings in the valuation case of the Potomac Edison Company have been concluded by the Maryland Public Service Commission. Arguments have been brought to an end and each side has filed briefs. The commission now has the subject under consideration. Representatives of the company placed a valuation of $19,470,590 on the electric properties of the company, while engineers of the commission value these properties at but $10,569,837.

▼

New Plant in Iowa

Iowa Electric Light & Power Company has completed a $300,000 plant midway between Tama and Toledo, Iowa, and is preparing for a formal opening. The power house includes two eight-cylinder 840-kw. Diesel-driven generators.

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Rate Reduction Avoids Tax

Approval by the Wisconsin Public Service Commission has been afforded a plan of the Black River Falls municipal electric utility to reduce rates by 3 per cent to save residential and commercial consumers the amount of the 3 per cent federal tax now in effect. In reviewing the fact that since the federal levy is applicable to domestic and commercial customers but not industrials, the commission found that in omitting the industrial users "the resulting rate schedules would not be unjust or discriminatory."

Maryland Auction Date Reset

The receiver for the Annapolis & Chesapeake Bay Power Company, Albert G. Towers, has fixed September 30 as the date on which the company's properties will be offered for sale at public auction. The sale will take place at the Court House, Annapolis. The receiver will sell the property under a new decree signed in the United States District Court, Baltimore, on a petition filed by the Consolidated Gas, Electric Light & Power Company (ELECTRICAL WORLD, September 3, page 292).

▼

Public Service Stockholders Up

During the first seven months of 1932 the number of shareholders listed on the books of the Public Service Corporation of New Jersey increased by 1,890, reaching a total of 91,340 on August 31, a new high record in the history of the corporation.

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Cookery Council Issues Plan Book

As the introductory step of the nation-wide co-operative movement to promote organized concentration on the sale of electric cookery, the National Electric Cookery Council has issued for distribution throughout the industry a plan book, outlining an energetic program for the promotion of the electric range as the new market for the electrical industry.

▼

No Power District for Oregon

Oregon Hydro-Electric Commission is without any proper legal authority to proclaim the official formation of the Tillamook public utility district on the ground that two voting precincts declined to lend approval to the proposed project. This is the holding of the state Attorney-General in an opinion written for the commission, and which virtually invalidates the results of an election just held for the purpose of determining the will of the people as regards to whether or not the district proposed be created. According to the opinion no such district can be formed unless each and every municipality and parcel of territory included in the project votes favorably for district creation. Consequently this particular district formation must be abandoned until further elections are held.

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Dnieprostroy Cost Data

Due to a typographical error the cost for the 756,000-hp. Dnieper River hydro development in Soviet Russia appeared in the August 27 issue of ELECTRICAL WORLD, page 257, as $11,000,000. This sum, according to the information available, should have been $110,000,000.

Westinghouse to Promote Three-Point Meter Plan

Through the co-ordination of three important elements in a plan for simplified and more economical domestic metering Westinghouse Electric & Manufacturing Company hopes to secure additional meter business at this time. The new system is applicable to old services as well as to new ones and its exploitation now logically follows President Hoover's inauguration of a rehabilitation program.

Essentially, the Westinghouse plan combines a new detachable watt-hour meter, the "nofuze" load center and stroboscopic meter testing. It provides for mounting the detachable meter on the outside of a house exactly opposite a "nofuze" load center installed in the kitchen, thus eliminating long runs of wiring, and for quick, convenient testing by means of a portable stroboscope.

The new meter, which is called by the company the type OC detachable, requires no expensive meter box, but the registering element is protected by a weatherproof case. Being outside it is always accessible for reading. The Westinghouse company estimates that the inaccessibility of indoor meters causes 15 to 20 per cent of the monthly revenue to be delayed a month unless return trips are made. When these are made the cost of reading, it is estimated, increases as the square of the number of trips. Detachable meters eliminate postcard schemes, save the meterman's time and promote customer good will by eliminating the necessity of interrupting the housewife's work.

The meter is designed to plug into and pull out of the circuit. This eliminates danger of injury to the tester. No permanently installed test facilities are necessary because of provision for easily carried test facilities. Elimination of test features installed at every meter saves, according to Westinghouse, approximately $1.25 per meter. The portable stroboscope effects quick checking and synchronization of the meter on test with one of known calibration.

The elimination of fuses by the use of small circuit breakers mounted in a "nofuze" load center is part of the plan, affording foolproof, easily controlled house circuit operation. To the central station it means less money spent on service calls and the customer's greater satisfaction with the service rendered.

Beginning this month Westinghouse will promote the combined application of these three pieces of equipment in the new metering system.

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Good Lighting Shows Reduced School Failures

Faced with the statements of educators that from 8 to 15 per cent of school children acquire defective vision within the few years of their school lives, engineers of the Alabama Power Company and the General Electric Company sought the aid of R. E. Thompson, superintendent of the city schools at Tuscumbia, Ala., in an experiment undertaken to prove that poor lighting in the average school is robbing the nation's children of good vision.

Two rooms were selected containing the same floor space and window area and with the same exposure to the sun. Each was already equipped with two 150-watt direct lighting fixtures controlled by a wall switch. In one this lighting equipment was permitted to remain unchanged, and in the other it was replaced with four 300-watt totally indirect fixtures controlled by a General Electric photoelectric relay or "electric eye." An equal number of pupils of the same rating were assigned to each room, care being taken to balance the groups in talents, intelligence and past achievements. The two-year test is said to have resulted in a reduction of 20 per cent in failures in the light-controlled room, as compared with the other room. Oculists and educators are reported to have viewed the experiment with interest.

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Electric Towing Popular Along French Canals

Electric towing equipment is fast replacing mules and horses on the French canals. Towing is effected by electric tractors operating on rails built along the canal banks and supplied with power by substations as far as 12 miles distant.

The canals and waterways between Paris and Belgium were equipped for electric haulage over a distance of more than 180 miles, of which 36 miles has been added during the last year. Mechanical towing apparatus has been in operation on the Paris-Strasbourg canal routes for more than a year, giving a marked impetus to Franco-Swiss traffic. On the canals connecting the Marne with the Rhine and the Meuse installation has been more recent, being in the course of construction at the present time or completed since the beginning of the year.

At the beginning of last June electrical towing facilities were available on 420 miles of canals in the north and east of France.

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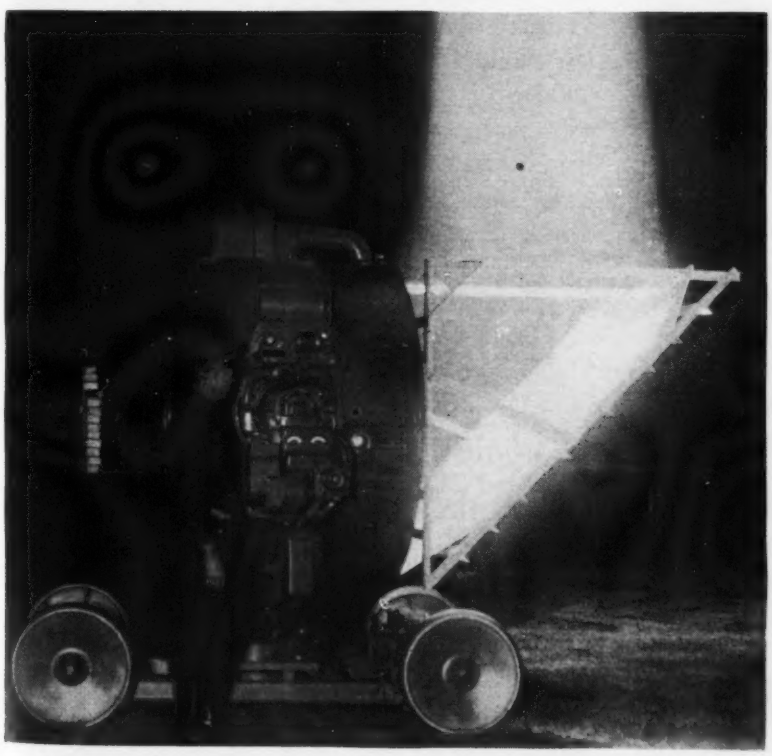
800,000,000-CP. SEARCHLIGHT HAS NINE BEAMS



Said to be a radically new idea in searchlights and one which greatly increases the anti-aircraft value of such services this equipment has just been demonstrated at Fort Totten, N. Y. By means of a series of mirrors placed at certain angles in a frame in front of the searchlight lens the single high-intensity beam is broken up into nine or more separate beams, thus greatly increasing the area lighted up. Experts claim it to be the first major advancement in anti-aircraft protection.

EDITORIALS

L.W.W.MORROW
Editor

The war about wiring materials

FOR more than five years there has been a war on among electrical men over wiring materials. The power companies have been demanding cheaper methods of wiring to cut down the cost of installations. The contractors have been promoting all-metal construction against all other approved materials. The manufacturers have split into several clans, each battling for his own. It has been a dog fight, with much good sweat and tears and untold energy wasted in the heat of family friction, that might have been applied to selling in the marketplace.

The electrical business is apparently not yet old enough to have shaken off its engineering viewpoint and become market-minded. Manufacturers of automobiles do not struggle to make the public or trade believe that the other type of car should not be used. They sell their own. Manufacturers of building materials do not attempt to keep the competitors' goods out of the marketplace. They sell their own. They know that their products will find their own place in public favor if they promote them with sufficient appeal.

The same opportunity awaits the champions of electrical wiring materials if they will bury their hatchets, long gory with each other's blood, and start working together to get more adequate installations in every home. The National Electrical Code approves various types of wiring as safe under prescribed conditions. A man can buy different grades of wiring just as he can buy different quality in socks. And the best quality costs the most and is worth it. A vast market has been built up for both cheap and expensive socks among the people who prefer to buy that way, and just so each type of wiring will prosper according to its appeal and worth.

The point is that destructive competition between products simply kills the market. The war about wiring materials has frittered away an infinite amount of thought and time and power that might have been applied to creating demand. Isn't it time to organize this energy into constructive co-operation in which each manufacturer will trust his product and his selling to bring him his share of the prosperity? Some progress has already been made in the Middle West, between the power companies and the electragists. After all, what is best for the public is best for the industry, and new material not yet approved may still be safe. Let's end this defense of products against progress.

Commissions should explain findings

THE closely knit reasoning which accompanies higher court decisions constitutes a major element of their value to the legal profession. The same thing is true in the field of commission regulation. In disputed cases both sides are entitled to be told why the adjudicating tribunal takes the stated position. The mere utterance, sometimes comprising the only comment in a decision of a regulatory body, that "the board, after giving due consideration to the facts, concludes that injustice will not be the result of the finding,"

lacks helpfulness as a guide toward future procedure. It deprives both sides of a necessary interpretation of the state's attitude toward the contentions at stake and it leaves unsettled points of interest which bear very closely upon company policies and relations with customers and public authorities.

Since correct decisions are the fruit of close study, the main lines of thought which guide a regulatory body to a specific finding should be defined in the commission's pronouncements. Interested parties are entitled to them in common fairness, and there can be little doubt that one of the main factors in the success and preservation of state regulation during the present century has been the frankness with which most of these tribunals have set forth their positions in controversial matters brought before them. The practice should be made unanimous.

Series rectifying tubes

IN ALL of the usual methods of connecting rectifying vacuum tubes for obtaining high continuous voltages from alternating circuits the tube is subjected, in the non-conducting half-wave, to the full alternating voltage. This limits the value of the voltage rectified to that of the flashover value of the tube. While such tubes have been constructed for 200 kv. or more, they must obviously be large and expensive, and as a consequence this simple method for obtaining a continuous voltage has not been practicable except in the relatively low-voltage range.

The series connection of a number of less elaborate tubes of lower voltage rating is obviously the next thought in an effort to utilize this principle. It is immediately found, however, that in such a series connection the capacities between filament and plate, and particularly filament and grid, appear as seriously disturbing factors. The distribution of alternating voltage over a series of such tubes results in great inequalities of the distribution of voltage, giving, in fact, a greatly exaggerated example of the same type of unequal distribution that arises in the case of a string of porcelain high-voltage insulator units. Just as in this latter case the conditions can be improved by an adjustment of the values of the capacities of the individual units, so it has now been shown that the same principle may be used for an equalization of the distribution of a series of rectifying tubes. As a consequence satisfactory operation is possible in a greatly simplified set-up for obtaining high-voltage direct current directly from the corresponding alternating-current circuit. The description of this development is found in the *Archiv für Elektrotechnik,* May 18, 1932, page 301.

Redistribution of capacitances between the series connected tubes is accomplished by shunting the individual tubes with external capacitance suitably graded through the series. The capacitances to earth through the filament circuit are adjusted by an actual space separation from earth potential of each separate filament, together with its heating source.

Very satisfactory performance of this unit is reported. Thus, these old principles in this new application should make it very much simpler than heretofore to obtain high continuous voltage, for which there is increasing demand for testing and other purposes.

Voltage surveys on a significant basis

MANY voltage surveys have been made a "spot" basis. Graphic meters have been installed in selected key locations on the distribution system, but in few cases have they been placed anywhere except on the secondary lines and services. The question still unsettled by the results of such a survey is what influence other loads and other system operating factors have upon the local range of customer voltage.

Any extended survey embracing the various radial links from bus to service entrance would be expensive from the standpoint of investment in meters. Nevertheless, there is much of value to be learned from a simultaneous record of load and voltage changes all the way from substation to customer meter. Chart instruments on both sides of the regulators, at primary load centers, at ends of laterals, on both sides of transformers, at secondary load centers, as well as at customer entrances, will show where correction may be applied most effectively and economically. The latter matter really constitutes a survey; the method first mentioned is hardly more than an ascertainment of compliance with standards.

Carrier-Current Relaying Proves Its Effectiveness

By PHILIP SPORN and CHARLES A. MULLER

American Gas & Electric Company, New York, N. Y.

WITH the general development of the 5- to 8-cycle high-voltage breaker and the modernization of many of the older type breakers to give substantially the same speeds the necessity for bringing the relay systems in harmony with this faster speed of breakers so as to take full advantage of their possibilities of fast clearing has become manifest.

To obtain high-speed relaying a number of schemes, each more or less limited, and many of them rather expensive, particularly when their limitation is taken into account, have been developed. Among them are the instantaneous overcurrent relay definitely set to clear faults within a definite distance of the outgoing bus, balanced line relays, which, of course, cannot be made to function when one of the circuits is out or when both circuits of a double-circuit line are in trouble and reactance and impedance distance relays of various types. Of these the latter two are by far the most elaborate; yet in spite of that they offer the possibility of satisfactory phase-to-phase protection only for approximately 80 per cent of the length of any particular section between which they are installed. The same objection as to lack of complete section protection can be raised against the scheme of using instantaneous current type relays, although these can be used both for phase and ground protection; obviously, however, as long as current is the only basis of selection complete protection cannot be obtained, and to obtain that some system of back-up relays must be depended upon.

The only relay scheme that has ever been proposed for giving complete and rapid protection to any line section over its entire distance, regardless of the type of fault and independently of the number of line sections between any two sources of supply, is the pilot wire scheme. This, however, has never met with any great favor in the United States on account of the prohibitive cost of the pilot wire circuits, particularly on long lines, and because of the fact that in the long run the scheme itself is no more reliable than the pilot wire, and experience has shown that the reliability of the latter is not quite at the 100 per cent level desired for service of this sort.

Solution for this difficulty was the substitution of a carrier current for the pilot wire and a practical scheme embodying this idea was developed several years ago and fully described in a paper before the A.I.E.E.*

But this scheme went totally out of its way in order to avoid placing of reliance upon any heretofore standard relay arrangement or combination of relays; the fundamental idea was to place reliance primarily in overcurrent (i.e., fault current) and in carrier. There was thus introduced a number of complications which in the final analysis militated against its wide adoption.

The soundness of the principle but also these complications were brought out in a series of tests carried out in 1927 and 1928 on the system of the Ohio Power Company on a section of line between Newark and Crooksville, Ohio (see Fig. 1). While even a brief description of the results of these tests is beyond the scope of this article (the data may, however, be completely presented at some time later), nevertheless it may be well for a thorough understanding of the simplified system to describe the principal weaknesses encountered and brought out during these tests. These were:

(a) The use of the common plate transformer introduced too many magnetic difficulties and made it substantially impossible to obtain proper plate voltage for all conditions of line-to-line and line-to-ground faults. In practice this meant the limiting, therefore, of the arrangement to either phase-to-phase or phase-to-ground protection.

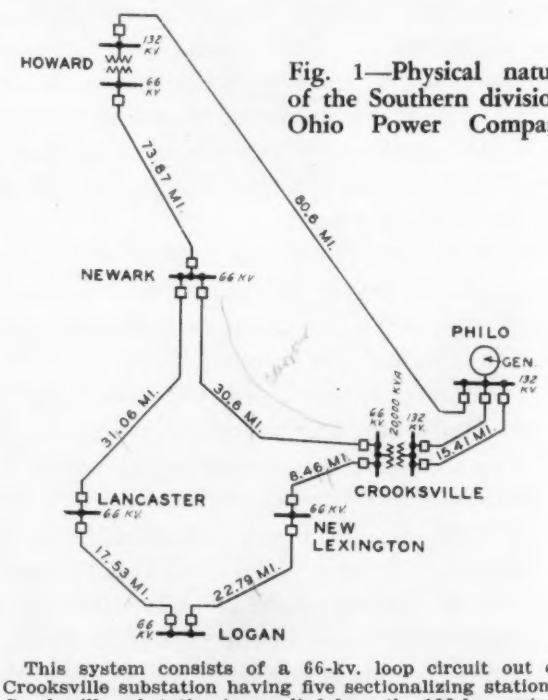


Fig. 1—Physical nature of the Southern division, Ohio Power Company

This system consists of a 66-kv. loop circuit out of Crooksville substation having five sectionalizing stations. Crooksville substation is supplied from the 132-kv. system through a step-down transformer bank, with the 66-kv. neutral solidly grounded. In addition, the loop has a second source of supply at Newark substation through a long 66-kv. line from Howard substation, which in turn is supplied from the same 132-kv. system. At Howard substation the 66-kv. neutral is also solidly grounded. The carrier protection was installed at Newark and Crooksville stations.

*A.I.E.E. Transactions, Vol. 47, January, 1928.

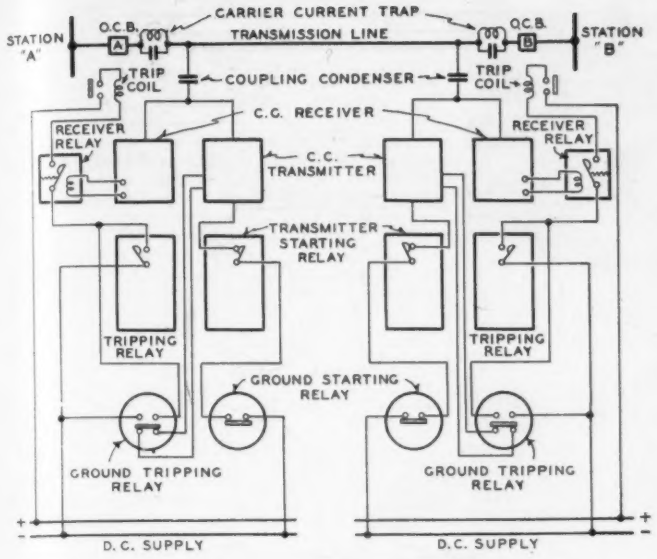


Fig. 2—Carrier serves in place of pilot wire

The operation of this equipment may be readily explained by describing what occurs on an external fault and on an internal fault. Assuming a single-phase fault beyond station B, the power flow at station A will be from the bus into the line and at station B from the line into the bus. At station A, the starting relay will have its contacts closed, thereby preventing the transmitter from sending out carrier current, and the tripping relay will start to close its contacts. At station B the starting relay will open its contacts, allowing the transmitter to send out carrier, and the tripping relay will keep its contacts open, thereby preventing the breaker from tripping. Since the transmitter at station B is functioning the receiver at station A will receive and operate the receiver relay, thereby locking out the trip circuit at station A. In case of a ground fault beyond station B the operation will be exactly similar except that the ground-directional relays will have full control of the operation. In case of an internal fault the power flow at both stations will be from the bus into the line. At both stations the starting relay contacts will remain closed and no carrier current will be transmitted by either transmitter. Also, the tripping relays at both stations will close their contacts to trip their respective breakers after a time delay of approximately 3 cycle. The operation in case of an internal ground fault will be exactly similar, but the ground-directional relays will do the functioning.

(b) The heavy volt-ampere burden placed on the secondaries of the transformers meant a minimum of approximately 300-amp. primary current to get satisfactory operation of the carrier-current equipment where bushing transformers were employed. Where this was not feasible instrument type current transformers had to be resorted to.

(c) The fundamental scheme of current actuation made it impossible to employ it on a line where load current normally fed from one terminal is in excess of the short-circuit supply from the second terminal of the section, without resorting to power-directional relays; the installation of this equipment, however, violated the very fundamental basis of the entire scheme.

(d) The scheme of operating the filaments with reduced voltage gave an unusually long time setting to the tripping relays (since time had to be allowed for the subsequent bringing up to full emission of the tubes). As a matter of fact, this speed was of the order of 30 cycles, and for a system as elaborate as this the speed did not appear fast enough.

(e) The complication of the equipment with the multiplicity of reactors, transformers, glow tubes, etc., had a natural deterrent effect since it promised the necessity of an excessive amount of maintenance to insure reliability of operation.

Nevertheless, this scheme did not stay as a laboratory arrangement and a complete installation on one of the large 220-kv. lines was actually made in 1929. This has been described previously in the ELECTRICAL WORLD.† In this arrangement phase protection was definitely waived and the carrier current relied upon to take care of ground protection only, and apparently under this arrangement the scheme has given a very good account of itself.

Although this original arrangement seemed to fall short of what an ideal and universal protection scheme ought to be, the idea seemed to be so inherently sound that work on it was continued and it culminated in the simplified system of protection now described.

Carrier-current pilot system simplified

In this arrangement it was recognized that the prime function of carrier was to exercise the function of the pilot wire, and thus permit its use for locking out the relays at the two ends of a section under conditions when trouble is outside the section. If this could definitely be depended upon, then relay arrangements or slight modifications of them could be employed to provide very fast relay action under conditions of internal fault.

The fundamentals of this scheme and the manner in which it differs from the old arrangement are thus as follows:

(a) The sole function assigned to carrier apparatus is to receive or transmit carrier current and when carrier is received to actuate a single receiver relay.

(b) The power required to operate the carrier-current equipment, both transmitter and receiver, is obtained from a small inverter operated from the station battery and is in no way connected with the current transformer circuit.

(c) Directional-power relays are employed at each station to determine in combination whether the fault is an internal or an external fault, and no phase relationship of carrier currents is necessary for this determination.

(d) The transmitter tube filaments are operated continuously from alternating-current potential at rated voltage and the life of the tubes is protected by employing a proper negative bias on the grid; this is removed when the transmitter begins to function in response to the starting relay. The receiver is prepared to receive under all conditions.

(e) By means of directional-power relays carrier is allowed to be transmitted by only one station at a time, that station being the one at which power flow is into the bus. This recognizes the fact that in a given transmission line section employing power-directional relays, the relay acting under power flow into the bus does its own blocking by its power-directional element. At the station where power flow is away from the bus blocking is not permissible if the power flow at the other end is away from the bus, but is necessary if it is into the bus.

(f) Speed of operation is greatly increased due to operating the tube filaments at normal voltage and employing circuit-opening relay contacts for starting the transmitters.

In Fig. 2 is shown a schematic diagram of this simplified arrangement. At each station the following apparatus is employed:

(a) Carrier-current traps, coupling condensers, receiver relays, similar to those in the original scheme and performing substantially the same functions.

(b) A carrier-current transmitter consisting of a simple master oscillator power amplifier unit, which normally has its grid biased, and a receiver consisting of a bias detector which operates the receiver relay when carrier current is received.

(c) A three-phase power-directional relay of the IDP type is employed for the transmitter starting relay and is so connected that when the direction of power flow is from line to bus the relay will open its contacts. Voltage restraint is employed on this relay to hold its contacts normally closed. This relay is adjusted to open its contacts practically instantaneously (½-1 cycle);‡ its function is to remove the bias from the master oscillator grid of the transmitter, thereby causing the transmitter to send out carrier.

(d) A similar relay is employed for tripping, so connected that when the direction of power flow is from the bus into the line it will close its contacts. Voltage restraint is again employed on this relay to hold its contacts normally open. It is adjusted

†*March 22, 1930, pages 580-583.*

‡*All times expressed in terms of 60-cycle system.*

to have a time delay of approximately 3 cycles. Its function is to trip the breaker after 3 cycles time, provided the receiver relay has not operated in the interim.

(e) For sensitive ground protection ground-directional relays of the ICP type are employed for tripping and starting relays; these perform the same functions as the three-phase directional starting and tripping relays. In addition there is employed an interlock on the ground-directional relay so that when it operates to trip the breaker it also opens up the plate voltage circuit for the master oscillator, thereby preventing the transmitter from sending carrier current no matter what the position of the contacts of the three-phase directional starting relay are.

Only one carrier frequency required

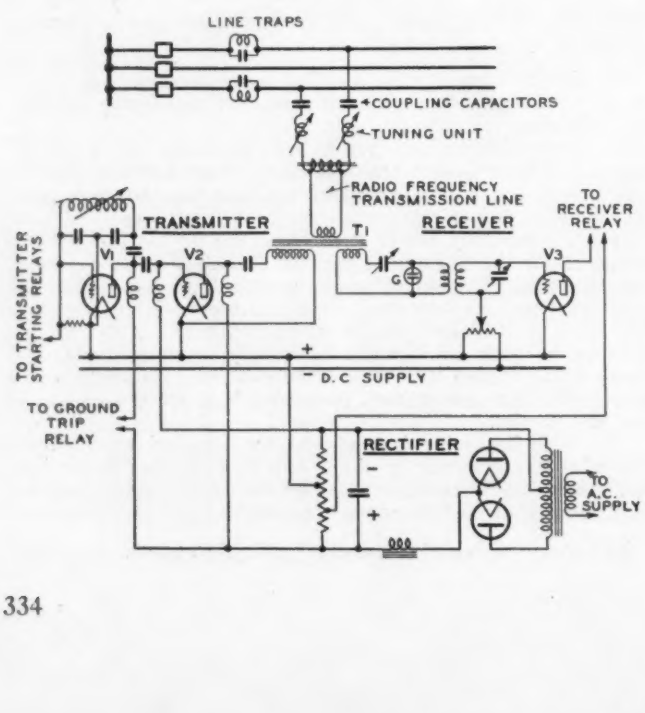
A single carrier frequency is used at both terminals. Fig. 3 is a schematic circuit of the carrier arrangement at each terminal. The equipment consists of a simple transmitter and receiver assembly coupled to the transmission line through the usual coupling capacitors and tuning unit. All plate filament and bias voltages for both the transmitter and receiver tubes are obtained indirectly from the station battery by using a small d.c. to a.c. converter and a plate supply rectifier. No grounds are placed on the station battery.

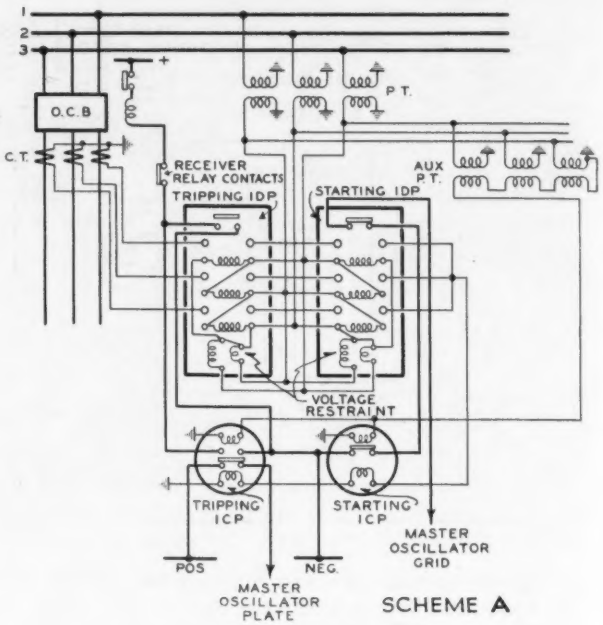
The receiver is prepared to receive signals at all times and does not introduce any appreciable time lag in this circuit. No harm is done if the receiver picks up signals from its own transmitter. When the transmitter is operated it is not necessary to receive signals from a distant station or to prevent energizing of the receiver relay. However, the receiver is protected against excess

Fig. 3—Two-tuned circuits used in receiver

The receiver employs two-tuned circuits coupled to the output circuit by means of a third winding on the carrier frequency output transformer *T-1* and a biased detector or relay tube *V-3* operating at a plate voltage of about 350.

The transmitter itself consists of a grid-leak type master oscillator driving a carrier frequency power amplifier. The output is not modulated. Normally the master oscillator is blocked by applying a negative voltage from the station battery to the grid circuit. This voltage is applied through the normally closed contacts of the transmitter starting relays and opening these relays starts up the master oscillator. Negligible time is taken for the master oscillator to start after the blocking voltage is removed by operation of a starting relay. The interlocking contacts of the directional ground tripping relay, when open, remove plate voltage from the master oscillator tube and prevent carrier transmission, regardless of the position of the transmitter polyphase starting relays.





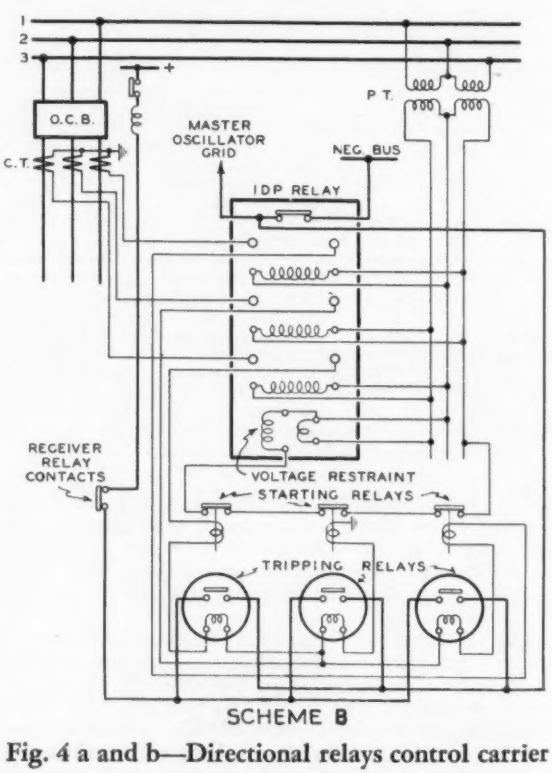


Fig. 4 a and b—Directional relays control carrier

In case of an external fault the instantaneous starting relays operate at both stations to remove voltage restraint from the IDP directional relays; and the tripping relays start to close their contacts at both stations. The instant that voltage restraint is removed from the IDP relay it operates solely as a high-speed directional relay. At the station where the power flow is from the line into the bus the directional relay opens its contacts, thereby opening the tripping circuit and preventing the tripping relays from opening up the breaker. In addition, the bias is removed from the grid of the transmitter which begins to send carrier. At the other station the power flow is of necessity from the bus into the line and the directional-relay contacts remain closed, thus not permitting the transmitter to operate. Carrier will be received by the receiver relay which will open up the trip circuit at its station. In case of an internal fault the power flow at both stations will be from the bus into the line, hence the relay contacts of the directional relay at both stations will remain closed and the transmitter will be inoperative. Therefore, the tripping relays at both stations will close their contacts and trip their respective circuit breakers.

Fig. 5—Locking out of trip circuit in 1¼ cycles

This oscillogram has been selected as a typical example of circuit performance under an external fault beyond Newark. As will be seen, the starting relay contacts opened at 0.8 cycle, starting the transmission of carrier. This is shown by the offset in the grid circuit element indication. This caused the local receiver relay to operate at 1.2 cycles after the short had occurred. This is shown by the small offset on the contact circuit element line. After the short circuit was cleared the starting relay required 2 cycles additional to close its contacts, thus shutting off carrier transmission. The local receiver relay then reclosed its contacts approximately 5 cycles later, or a total of 7 cycles after the fault had cleared. The tripping relay at Newark, of course, kept contacts open as the direction of power flow was into the bus.

voltage from its own transmitter by a small glow tube (G). The arrangement results in a simple, relatively insensitive, receiver capable of supplying adequate power to operate the receiver relay.

Freedom from interference due to static or arcing grounds is obtained by using adequate power in the transmitter, together with a very insensitive receiver and adequate margin on the receiver relay. However, the transmitter power required is normally low because the transmission losses between terminals are low and the use of line trap units eliminates losses outside the section of line being protected.

Fig. 4 represents the wiring diagrams for the relay arrangements for two schemes, A and B respectively. Scheme A is employed where directional ground relays are desired and scheme B where directional ground relays are not necessary. In scheme A three high-voltage potential transformers, two type IDP directional-voltage restraint relays, two type ICP directional-ground relays and three auxiliary potential transformers are necessary. The operation of this scheme has been explained in the discussion of schematic diagram Fig. 2.

In scheme B only two high-voltage potential transformers are necessary and even these may be dispensed with by using low-voltage potential transformers connected to the low-voltage busbars of the station. Also, only one three-phase directional-voltage restrant relay is necessary. There are needed, however, three additional instantaneous circuit-opening overcurrent relays and three definite time-induction overcurrent relays.

Field tests demonstrate a practical installation

Although this new development had withstood all laboratory tests and although sufficient experience had been gathered both with carrier separately and with the relays themselves over many years, nevertheless it was felt that the combination might have some flaw in it that did not appear evident either upon analytical investigation or in laboratory tests. The previous experience with the other arrangements described had left a definite feeling that no positive assurance was to be placed in anything but a complete field test. Besides it was particularly desired to test out the relative adequacies of the arrangements of schemes A and B shown in Fig. 4. Accordingly a complete schedule of tests was outlined covering all the various types of faults which might be encountered and at locations both internal and external to the section to be protected, and at both ends of the section. It was sought by means of these tests definitely to prove the following:

1. That for all types of faults external to the protected section carrier is received to prevent tripping at the station where power flow is from the bus into the line.
2. That for all types of internal faults carrier is not received at either station.
3. To determine the maximum speed allowable for the tripping relays without the occurrence of faulty operations on through faults.
4. To determine the effect of arcing short circuits on the reception of carrier.

It was not felt that there was anything left to be learned with regard to the behavior of directional relays under various conditions of line potential, the reliability of the three-phase directional relay under all conditions except dead short circuit at the station bus and of the ground-directional relay having been definitely established over many years of operating experience.

For the purpose of actually producing short circuits at Newark a three-pole breaker was employed in series with three single-pole disconnects. Taps were made directly from the line to be short circuited through the disconnects to the poles of the breaker. This arrangement made it possible to produce phase-to-phase or phase-to-ground or three-phase short circuits as desired. At Crooksville a single-pole breaker in series with three single-pole disconnects was employed for the same purpose. This, of course, did not permit any three-phase short circuits. Arcing grounds between any two points were established by connecting a fuse wire between them.

Oscillographs were installed at both stations, a nine-element oscillograph being used at Newark and a six-element instrument at Crooksville. At each end the oscillographs were connected to measure operation of starting, receiver and tripping relay contacts, master oscillator grid current, secondary residual current, voltage on directional-ground relay, secondary phase current and line voltages, only one of these being possible at Crooksville.

A total of 25 short circuits was made. At Newark these con-

sisted of eight external and four internal faults. Of the eight external faults four were single phase to ground, two were two phase to ground and two were phase to phase. Of the four internal faults two were single phase to ground and two were phase to phase. At Crooksville eight external and five internal short circuits were made. Of the external faults four were single phase to ground and four were solid phase to phase short circuits. Of the internal faults two were solid phase-to-phase short circuits, one was a phase-to-phase arcing short and two were arcing grounds. Each type of short circuit was established twice, once using scheme A and once using scheme B, an exception being the phase-to-phase arcing short at Crooksville, where only the scheme A was tested.

An analysis of the completely tabulated data shows that for all types of external faults carrier was received to block tripping at the station where power flowed from the bus to the line. The time required for the blocking relay to pick up varied from 1.0 to a maximum of 1.7 cycles after the occurrence of the short. In tests 17 and 18 the blocking relay at Newark failed to pick up, although carrier was properly transmitted from Crooksville, but this was due to the relay contacts being welded shut from the previous test. The welding of the contacts of the blocking relay in test 16 was due to this relay not being provided with a holding coil and thus when the contacts bounced while closing the trip circuit the resulting arc welded the contacts together. This action will be prevented by supplying a holding coil for the blocking relay similar to those employed on all tripping relays.

Carrier not transmitted on internal faults

For all types of internal faults, except as noted below, carrier was not transmitted. The total time on these faults from the occurrence of the short circuit to energizing the breaker trip coil ranged from 3.0 to 5.5 cycles.

In test 15 (internal fault) at Crooksville the oscillograms show that the IDP relay opened up after 3 cycles and stayed open for 1 cycle, then opened again at 5 cycles, stayed open for another cycle, thus operating the local receiver relay. Tripping was delayed 3 cycles after the tripping relay closed, making a total time of approximately 7 cycles. In test 16 at Crooksville a similar action took place, the starting IDP opening up after 1 cycle, staying open for 0.6 cycle, reopening at 3 cycles and staying open for 1 more cycle, thus operating the local receiver relay. In this case tripping was delayed approximately 2 cycles after the tripping relay had closed, making a total tripping time of 7.5 cycles. The probable explanation of the action of the IDP relay in tests 15 and 16 is that the heavy current resulting from a short circuit close to the Crooksville bus produced a very high torque, tending to hold the IDP contacts closed, and brought them together with such force as to cause them to bounce open momentarily. This, of course, can be remedied by proper adjustment of contact pressures.

The results of these tests make it apparent that the time for the starting relay to open its contacts can be made approximately 1 cycle. The time required for the receiver relay to open its contacts after receiving carrier is approximately 0.2 cycle, thus requiring a total of 1.2 cycles for the trip circuit to be blocked for an external fault. Hence the total time for the tripping relay to close its contacts might be made 2 cycles; it is probable, however, that for safety it is desirable for the present, at any rate, to make it a minimum of 3 cycles.

The development of a simple, workable and reliable system of pilot protection will mean to the system planner and designer freedom for the first time in planning his lines as and where they are needed without any regard to switching or other complications that might be involved and which might act as a hindrance to proper relay protection under present relay practice. Further, it means

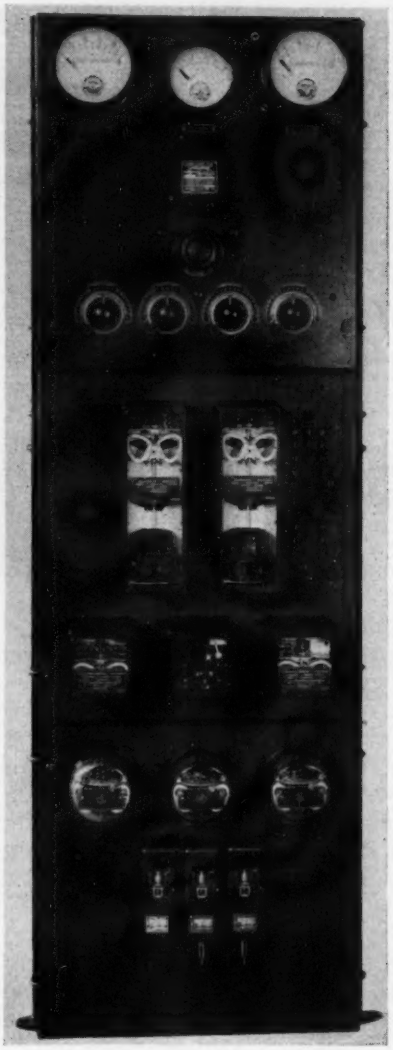


Fig. 6—Compact panel for two schemes tried out

It embraces all the relays used in both schemes A and B as shown in Fig. 3 as well as the carrier-current transmitting and receiving apparatus. The top panel includes the same transmitter and receiver apparatus for both schemes. The middle panel includes the relays for scheme A and the bottom panel includes the relays for scheme B in conjunction with one of the directional relays and the receiver relay on the middle panel.

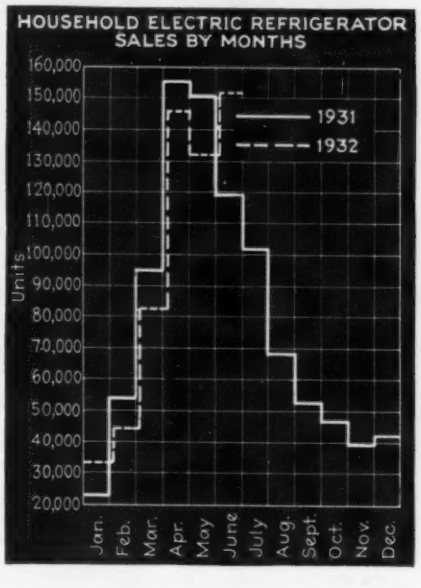
that the number of sectionalizing points that can be installed between any two main sources of feed has for the first time been made almost infinite, since each line section provides its own protection and the speed of that protection will be the same for all sections and will be independent of the total number of sections operated. Installed on existing transmission systems, by insuring high-speed relaying over the entire range of a line, it will of course mean improved system stability. Similarly in those sections of the country where the probability of lightning damage is particularly great, this system of protection ought to reduce this source of system difficulties to an almost negligible quantity. It ought to prove of particular benefit in cases of double-circuit lines where two-line trouble is a frequent occurrence, since all present relay schemes (except pilot) are particularly weak in this regard when taken over the entire length.

The arrangement in its present form has definitely proved the feasibility of getting positive locking out on through faults and still get positive energization of trip coils of the breakers involved in an internal fault in a maximum of 3 cycles. Until breakers are further developed to a point where their speeds are considerably better than those obtainable at the present time and are at least equal to the described relay time of three cycles, it would appear as if nothing could be gained by further speeding up of the relay arrangement. However, there does not appear to be much doubt that the present arrangement will permit of speeding up to approximately one half the best obtainable at the present time; that is, it would permit complete action within 1½ cycles. The next move, if there is any economic advantage to be derived from doing so, would appear to be definitely up to the breaker.

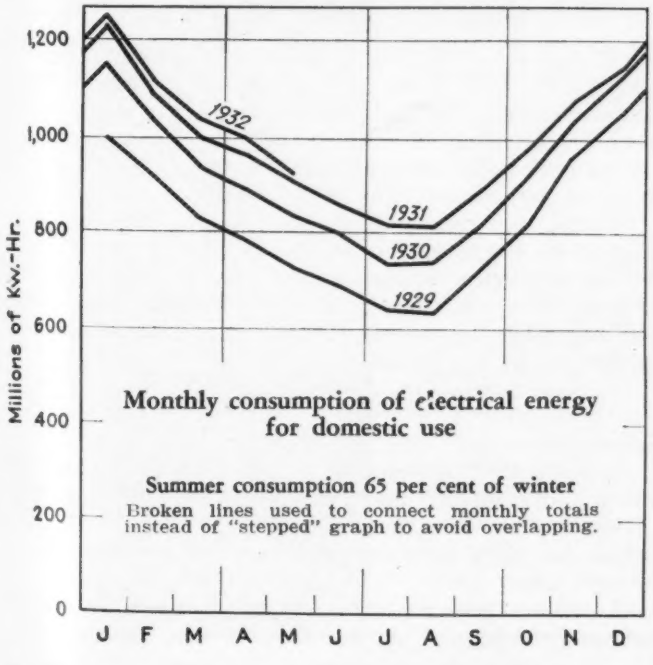
Filling the Summer "Valley"

Less energy by fully one-third is used for domestic purposes in a midsummer month than in midwinter. For the country as a whole and at the present rate of consumption this means a difference of some 400,000,000 kw.-hr. between January and July. At the same time, and despite lagging sales in most commodities during the past few years, residential energy sales have been steadily mounting; month by month previous records are being broken.

Probably the most favorable immediate prospects for adding to the warm-weather load, while building up winter consumption to a lesser extent, lie in domestic refrigeration. Air cooling, as it comes more and more into use, will offer another field. That this market is being actively built up is evident from the reported sales of domestic refrigerators, which aggregated 1,448,734 units during 1931 and the first half of 1932, according to the Electric Refrigeration Bureau, N.E.L.A. Monthly sales during the past two years are shown herewith in chart form.



This filling of the "valley" in the load curve benefits not only the manufacturers and the power companies but the public as well. Every change that spreads out the use of generating and distribution facilities over more hours of use decreases the average overall production, distribution and delivery cost per kilowatt-hour. The result, as in the past, is a progressive reduction in the rate charged for energy.



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Supplementing General Lighting Gives Better Results

By M. LUCKIESH
Director Lighting Research Laboratory, General Electric Company, Cleveland, Ohio

Throughout the engineering world it is standard practice to make the design specifically meet the requirements of the work. Even with the great emphasis that is being placed upon standardization the factor of uniformity is second to efficiency. But in a large measure this practice has not yet been adopted in lighting for the work-world. In this field of lighting a general formula—general lighting—is being applied to a vast variety of visual tasks.

Few jobs have the same requirements as to quantity and distribution of light. General lighting at a uniform intensity by prescription has, therefore, the disadvantages of a blanket method, much the same as supplying an army with shoes of a standard size. Such a procedure, in the case of lighting, has not yet become wasteful, since the present standards of general lighting are not too high and should not be lowered. The undesirable feature of the general uniform-lighting method is that many visual tasks are far from being properly and adequately illuminated owing to the economic difficulties of obtaining the necessary level of illumination and to the impossibility of obtaining the best distribution of light for individual visual tasks. In many types of work high-intensity lighting is a matter of a hundred or more foot-candles—not merely 10 or 20 foot-candles.

High-intensity campaigns of general lighting have been carried on for years and the levels of general lighting have been progressively raised. However, the sales resistance to levels of general illumination above 20 foot-candles becomes severe since the most obvious and important advantages of general lighting are already being realized at that level. In order to show reliably the improvement of an additional 20 foot-candles an elaborate analysis of production under the two intensities is required. Thus the selling of higher levels of general lighting becomes a matter of presentation of facts and figures rather than a simple demonstration of obvious merit.

Supplementary lighting offers a fresh field for bettering conditions for seeing. At critical points, where the workman admits the desirability for more and better light, a high intensity of supplementary lighting may be easily and properly directed upon the work. The demonstration of its effect upon clear seeing can be made instantly by switching on and off the specially designed supplementary lighting. The determination of its effect upon production is likewise a simpler matter in the case of individual tasks.

If lighting in the work-world is to progress toward the ideal it must take the step of adding to good general lighting an adequate supplementary lighting, of proper quality and distribution for the specific visual tasks.

Governor Balances Power and Steam

By E. L. CHAFFEE
Leland S. Rosener, Consulting Engineer, San Francisco, Calif.

INSTALLED at the Emeryville, Calif., plant of the Paraffine Companies is an unusually versatile turbine control mechanism, operating on the single turbo-generator unit, which provides both power and process steam for plant operations. This plant, manufacturing a large number of products, needs large amounts of process steam, which is supplied from the turbine's exhaust. Inasmuch as the steam passing through the turbine is entirely used for process work, it is necessary that the steam admitted to the turbine, and consequently its electrical output, be governed by the factory demand.

Under normal operations the demand for steam in the factory governs the turbine operations, but to overcome the inherent speed variations from this type of operation the unit is operated in parallel with an outside source of power, which serves to maintain a constant frequency on the factory circuits, to supply electrical demands in excess of the turbine output, and to provide standby service in case of service shutdown.

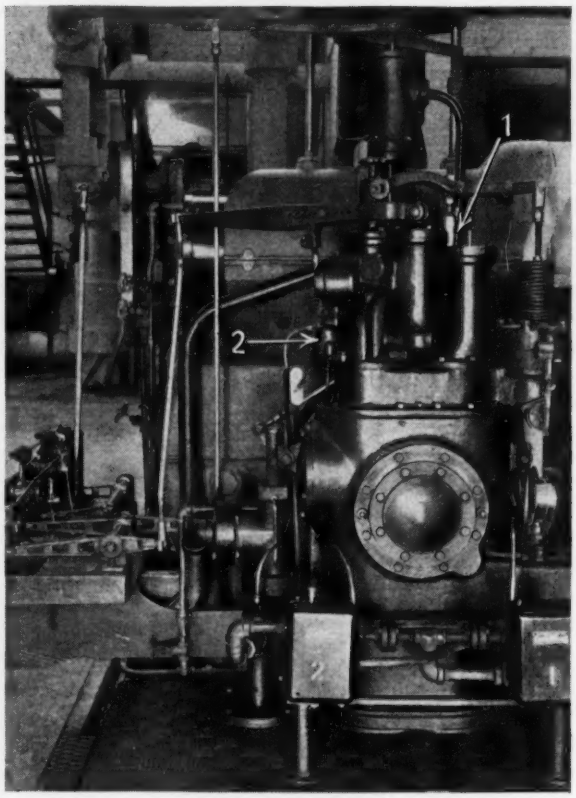
Under such a scheme of operation failure of the outside power source would create undesirable situations. If the factory demand for exhaust steam at the time power failure occurs is not sufficiently great to generate electrical power up to the factory's electrical demand the turbine, being called upon to carry additional kilowatts with no additional steam supply, loses speed. Frequency and voltage drop rapidly and a factory shutdown occurs.

If, on the other hand, steam demand is causing generation of more power than the factory requires the turbine will increase in speed and may trip out its overspeed protection, which will also cause a plant shutdown. Only the most skillful operation by a power plant attendant could prevent shutdown in such instances, and in cases of extreme load unbalance interruptions are very likely to occur.

To avoid power interruptions from these sources an automatic control device was designed which functions to care for all possible conditions of load immediately upon failure of outside power. Essentially, failure of the outside power source places the turbine under the control of its centrifugal governor, which is automatically reset to maintain a 60-cycle speed. Operating non-condensing, the turbine then assumes full electrical load of the factory, and if the electrical output is in excess of wide-open-throttle steam admission portions of the non-essential factory load are dropped. The control takes care of three difficult operating conditions in the following manner:

Should the factory steam demand be in excess of that required to generate the electrical load demand the additional steam required is automatically furnished through reducing valves.

Should the electrical demand be in excess of the electrical generating capacity of the exhaust steam requirement of the factory the turbine will carry up to its full kilowatt capacity, exhausting excess steam above factory requirements to the atmosphere through relief valves until such time as the outside source of power is restored and normal operation resumed.



Turbine governor changeover and reset mechanism

Fulcrum No. 2, actuated by oil pressure controlled by solenoid-operated valve No. 2 at the lower center of the illustration, changes the turbine control from the normal low-pressure steam governor (the linkage on the left) to the centrifugal governor. Fulcrum No. 1 changes the latter from a pre-emergency setting to a 60-cycle operating speed, also being operated by oil pressure controlled by solenoid No. 1 at the lower right.

Should the factory electrical load be greater than that which the turbine is able to carry with its throttle valves wide open arrangement is made to drop selected groups of non-essential load at definite intervals until the total electrical load is reduced to a value which can be carried by the turbine.

Equipment necessary to perform these operations falls into three groups, instruments, mechanical devices and power relays.

Instruments—Instruments consist of one under-frequency, one under-voltage and one over-voltage relay. These initiate the various changes in turbine load set-up due to the conditions in the electrical circuit which require them.

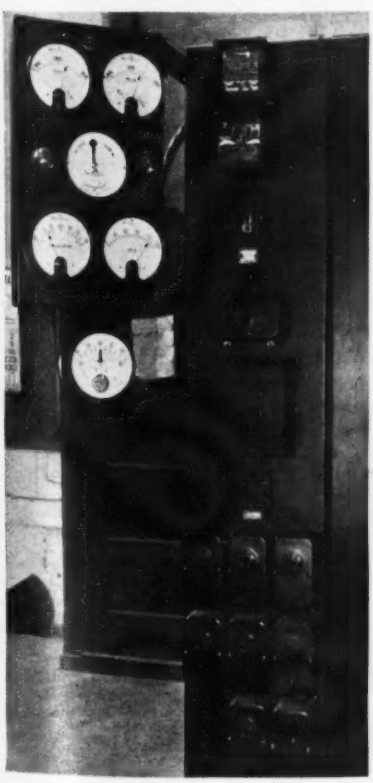
An under-frequency relay has its operating coils permanently connected across the 110-volt circuit. Its

Output of Turbine

Industrial plant turbine unit supplying varying amounts of process steam operates in parallel with central-station service, being controlled by automatic device which balances electrical output against steam demands, with atmospheric exhaust and load dump provisions in case of power failure.

contacts, which in this instance are arranged to close at 57.5 cycles and to open again at 59.5 cycles, actuate a power relay which operates the load-dumping control. This relay also actuates a second power relay which de-energizes the solenoid-operated valves, which respectively change the turbine from pressure to centrifugal governing and set the centrifugal governor to 60-cycle speed. The operation of this second power relay also opens the holding circuit on the breaker which normally parallels the outside power to the station bus. This removes any possibility of the power coming back on the station bus out of phase and also operates a device which limits the value of generated voltage. This second relay, having operated, seals itself in and may be released only by the operation of a button marked "Governor Reset."

The operating coils of the under-voltage relay are also connected permanently across the 110-volt circuit. Its contacts operate the second power relay mentioned above and consequently it initiates all of the actions previously mentioned except the selective load dumping. Inasmuch as either low voltage or low frequency will drop out starters all over the factory and cause a shutdown, it is, of course, equally important that the power plant be isolated from the source of outside power and carry the factory load alone under either condition. An overload on the plant turbine will always be indicated by falling of frequency, and consequently the frequency relay only is arranged to actuate the load-dumping control which lightens the kilowatt demand until it is within the limits of the generating unit. As the power plant turbine normally operates in parallel with an outside source which is very much larger, any change in the excitation carried on the plant generator will not affect the bus voltage, but will only operate to change the power factor at which the turbo-generator operates. In order to secure the best possible power factor for that load supplied by the outside source the excitation of the power house generator during normal operation is carried at its maximum value. Under this condition, if the factory electrical demand should be light at the time of failure of the outside power source, the bus voltage would be raised to a dangerous value as soon as separation occurred. To prevent this, arrangements have been made automatically to insert additional field resistance at such time as the breaker opens.



Switchboard relay panel

Controlling turbine governor changeover and reset solenoid-operated valves and automatic load-dumping features. In order from top to bottom are the frequency relay, low-voltage relay, high-voltage relay, definite time relay controlling load dump interval, governor reset and load reset buttons, and eight auxiliary relays.

This provides for the case where separation occurs through opening the power plant tie breaker, but should separation occur by opening the supply line at some other point the danger of excess voltage still exists. To provide for this situation an over-voltage relay is provided, its operating coil permanently connected across the 110-volt bus. The normally closed contacts of the relay are in series with the holding coil of the tie breaker, and any bus voltage in excess of the maximum value for which the over-voltage relay is set will cause the tie circuit breaker to be opened, actuating the voltage-limiting device which keeps the bus voltage to a safe value.

Mechanical Devices—These consist of two solenoid-operated valves and two oil-operated pistons. Each valve controls the admission of oil pressure to its corresponding piston, or the bleeding of that pressure back into the main turbine reservoir. The pistons normally operate under pressure at such times as the turbine is paralleled with the other power source and is under control of its low-pressure governor. At such times one of these pistons holds the governor linkage in such position as to make the low-pressure governor operative, and the other holds the setting of the centrifugal governor at a point corresponding to a machine speed of approximately 63 cycles, so that it may not interfere with the operation of the pressure governor.

At the time that separation occurs the pressure is removed from each of these piston fulcrums. The first resets the governor linkage to such a position that the centrifugal governor becomes operative, the pressure governor inoperative; the second moves to a definite position which sets the centrifugal governor from its 63-cycle location to a 60-cycle setting.

Power Relays—Power relays are so connected as progressively to dump selected portions of non-essential load at regular intervals in case the electrical demand is too great for the generating capacity of the turbine. They function only as long as the turbine is operating up to capacity.

In this factory, as in many others, there are certain

portions of the load which may be shut down without causing serious inconvenience in operation of the remainder of the plant. In this particular plant parts of the load may be dropped completely for over an hour without affecting the balance of factory operation. This interruptable load has been divided into three groups, each controlled by a separate circuit breaker.

By the use of standard power relays plus one time-delay relay and one adjustable definite time relay an arrangement has been worked out which will permit the unloading of the first of these three load blocks at a definite length of time after the low-frequency relay has operated and the remaining blocks at equal intervals, determined by the definite time relay setting. Subsequent to the dropping of the first load block, another equal time period elapses. If the frequency of the power on the station bus has not returned to at least 59.5 cycles during this time the second load block is dropped, and, likewise, the frequency failing to rise sufficiently after a third time period the third block of load is released. These load blocks are so proportioned that the dropping of the third one will care for the heaviest possible present factory load.

After "load blocks" are dropped

If after any of the above blocks has been dropped the frequency returns to normal, indicating that the turbine is again running under a demand that it can carry, no further load will be dropped and the power plant will continue to carry the diminished factory load at 60-cycle frequency. If, however, at any subsequent time an increase in the factory demand causes the load to again be too great for the turbine capacity, as soon as the frequency has remained at a value of 57.5 cycles for the length of time for which the definite time relay is set, the next block of load will be released.

When the turbine is again paralleled with the outside power source and normal operation has resumed a pushbutton marked "Load Reset" may be depressed and the tripped-out breakers reset for normal operation.

The equipment described cares for every condition which may develop when the factory power plant is separated from the outside source of power, and does it immediately without any attention from the power plant operator. He is not required to perform four or five operations which must be accomplished simultaneously at widely different points, and there is no chance for error due to confusion resulting from unusual conditions which occur so infrequently that the steps necessary to correct them are not clearly remembered. The operator is free to attend to his regular duties and operate boilers as necessary to care for added or diminished load.

When the outside source is ready to resume service, he may parallel in the usual manner, then replace turbine on the pressure governor by pressing the button marked "Governor Reset." Then, after operating the "Load Reset" button, the tripped out load breakers may be reclosed and the whole plant again will be placed in normal operation.

The new equipment was designed to eliminate completely factory shutdowns from power interruptions. It had been in operation over six months up to the time this article was prepared and had been called upon to function under various factory load conditions, each time fulfilling its purpose exactly as anticipated.

This control, which can be adapted readily for practically any load conditions and may be applicable and desirable in many other plants using process steam, was designed by Leland S. Rosener, consulting engineer, San Francisco.

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Southern Farmers Using More Electricity

By E. C. EASTER

Chairman Rural Electric Service Committee, Southeastern Division, N.E.L.A.

More than 200 kw.-hr. annual increase per farm customer during 1931 is shown by nine Southeastern power companies serving 19,093 farms. Table I gives comparative data for 1930 and 1931 for all rural customers of these companies and it shows the effects of increased farm consumption on the whole class of rural business. Of the number of customers in Table II, from the records of the Alabama Power Company, about 65 per cent are farms and the balance are rural residents,

Table I—Increase in Rural Business—Six Southeastern States

Year	Number of Farms	Total Annual Kw.-Hr. Sales	Annual Kw.-Hr. Sales per Farm Customer	Increase in Annual Kw.-Hr. Sales per Farm	Per Cent Increase Over Preceding Year
1929.....	13,228	10,899,576	620	...	....
1930.....	17,405	16,112,513	930	110	11.3
1931.....	19,093	21,777,818	1,140	210	23.0

Table II—Increase of Rural Business, Alabama Power Company

This table includes only those customers served from rural lines to which the rural rate is applicable and does not include customers served from rural lines at industrial power rates nor customers on lines transferred from rural classification.

Month	Rural Customers 1930	Rural Customers 1931	Total Kw.-Hr. Sales 1930	Total Kw.-Hr. Sales 1931	Kw.-Hr. Sales per Rural Customer 1930	1931	1932
January.....	5,113	6,099	345,997	456,371	68	75	82
February.....	5,236	6,049	345,892	434,637	66	72	77
March.....	5,382	6,060	335,133	393,731	62	65	74
April.....	5,883	6,142	360,300	420,239	61	68	..
May.....	5,848	6,244	373,723	432,488	64	69	..
June.....	5,937	6,299	391,529	464,614	66	74	..
July.....	6,010	6,366	426,741	537,307	71	84	..
August.....	6,086	6,397	459,393	553,652	76	87	..
September.....	6,120	6,351	461,383	548,530	75	86	..
October.....	6,115	6,311	450,897	531,879	74	84	..
November.....	6,121	6,256	449,616	508,926	73	81	..
December.....	6,228	6,212	436,137	503,486	70	81	..
Total.....			4,836,741	5,785,858	828	928	..
Aver. per month	5,840	6,232	403,062	482,136	69	77	..

country stores, churches, schools and small rural community enterprises. Through an analysis of individual records it was disclosed that during the two-year period of the table the increased energy consumption was due to large increases by farm customers and that there was an actual decrease in the consumption of other rural customers. In 1929 65 farm customers of the company used an average of 10,850 kw.-hr. each. In 1931 these same farms used an average of 12,400 kw.-hr. These conspicuous increases indicate that wide-awake farmers are making profits by using electricity freely.

Is Frequency Regulation the Fundamental Problem?

By H. A. DRYAR*
Philadelphia Electric Company

I SOMETIMES wonder if in our efforts toward securing an accurate instantaneous frequency we are not blindly adhering to an old fetish that was passed down to us through the years of operation of the electric power system. The rapid development of the electric utility industry has probably tended to prevent an inquiry into the reason for the mandate to hold accurate frequency. We have failed to question the reasons advanced by those favoring a minimum variation in frequency. We have accepted, without consideration, the dictum that the narrower the frequency band the better, because of its universal acceptance.

So let us ask ourselves the question, "why is it necessary to hold the frequency to a minimum variation, to so regulate that the curve shows a straight and narrow line?"

It is said that production of the industrial customers would suffer with variable frequency. Yet, on the modern large system and on those systems that are part of a large interconnected group, the frequency variations normally possible are of the order of but one-sixth of 1 per cent. This change would have but a negligible effect on the production of any industry. The inertia of the modern large system to change in speed, due to its great flywheel effect and the ready response of the governors of the generating units to changes in load, tends to a narrowing of the frequency band.

Does the need for accurate frequency regulation arise because it is essential for the supply of correct time? The average frequency regulation that is inherent in the operation of the present-day systems may be equally as satisfactory for time service as the regulation controlled by automatic equipment.

Will a finer regulation of frequency reduce the variations in tie-line loading? If we review the operations of the past we recall the difficulties attending the loading of tie lines. These difficulties were especially severe if the tie lines were of some length and of relatively small capacity. But even where the ties were of larger capacity and shorter length there were variations in the loading that demanded constant attention. These variations in many instances were a result of the attempt to correct for frequency variations, and further aggravated by a seesaw action when the operators at stations other than that or those doing the regulating attempted to hold their scheduled load regardless of the frequency. The variations were further increased due to inability accurately to distinguish the indications of the reed-type frequency meter.

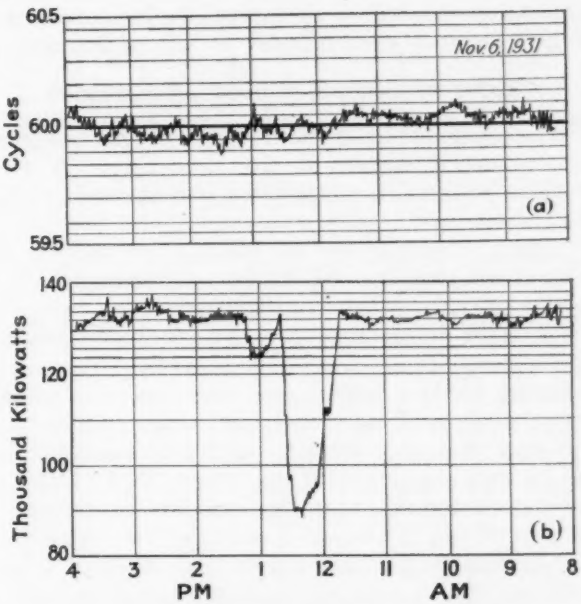

Fig. 1 a and b—System frequency and load on station previously assigned regulation

All stations are assigned a definite proportion of system load which is allowed to vary slightly as governors respond to variations, thereby sharing variations in system load and reducing the burden on any one station and on the lines. Note particularly the regulation during the rapidly changing load period at noon.

Load variations relatively greater in 1916

Let me carry you back to the regulating station of the year 1916. The system load was subjected to a much greater variation proportionately on the plateau of the curve than now. The diversity in load changes of the larger system loads of the present day has, as a percentage of the total, considerably reduced this fringe. At the time we are considering, however, the load changes resulted in frequency variations of the order of one-half cycle. In correcting for these variations the tie-line load swings were of such magnitude that ties of large capacity were required to hold the stations in parallel. In my opinion, the operator did not have a true picture of his regulating activities. To him the practice followed when the system load was carried by an individual station applied also when other stations operated in parallel with it. It probably did not occur

*Based on discussion of system operation before Pennsylvania Electric Association committee.

to him that the great variations in load on the tie line were a result of the changes in load on the regulating station. By partial correction of the change in speed, allowing for a change in load in the opposite direction, he would narrow the change of load on the tie line. Should the other stations permit their loads to vary with the system load changes the tie-line load changes would be still smaller.

Failure to sense this basic thought in regulation seems to have persisted. As the system load increased the fringe or variation of load was a smaller percentage of the total. The variations, however, were greater in amount and the regulating station was subjected to a burden that resulted in an appreciable loss of economy. Various methods were adopted to reduce this loss.

Different methods of handling regulation

Some companies assigned the duty of regulation, manually, to several stations at the same time. A seesaw condition resulted, and while the burden on one station was reduced, the other stations suffered a loss in economy, thus subjecting the system to a greater loss than experienced when but one station was regulating.

Other companies assigned the regulation to but one station, with the instruction to permit the frequency to vary within certain limits. This method reduced the variations on the station and improved the economy. The other stations on the system were assigned a definite load that they were to average, permitting their load to vary slightly with the system load swings. If the operator could at the average of the swing have the normal instantaneous frequency, the chart would be an extremely good one and secured with the minimum of effort. If he were not successful in doing this the chart would be somewhat uneven, but satisfactory from the standpoint of time and the service to industrial customers. The variations in load on the regulating station, however, were objectionable. A reduction in these swings was effected by partial correction of the frequency error and permitting the change of load in the opposite direction to complete the correction.

Still other companies installed automatic frequency control that proved very successful in holding the frequency to the instantaneous value desired. The load variations on the regulating stations, however, with higher system loads proved a burden. This burden became heavier when the system was interconnected with others. In some instances, where the regulation was automatically controlled, it was found necessary to take the regulator out of service or to increase the tolerance of the controller so that the variations in load on the station would be limited.

Where the regulation on an interconnected group was assigned to one station and the control was manual an appreciable improvement in the curve as compared with previous charts of manual regulation was evident. This, of course, was due to the decreased percentage of variation, the increased inertia of the combined load and the greater response of the increased generator capacity operating in parallel. However, the demand on the regulating station was heavier, and it was essential that measures be adopted to reduce the loss in economy.

It seemed necessary for each system of the interconnected group to assume its share of the burden of regulation. To do this manually would be a backward step. The seesawing produced by this method of operation would make matters worse. Installation of automatic frequency control, on each of the systems of the group, seemed the logical step to take. Each member of the interconnected group would then be in a position to aid in the regulation, and the consensus of opinion indicated that tie-line variations then would be negligible.

Reduce the swings on regulating stations

You will notice that emphasis was placed on the need for reducing the swings on the regulating station and that consideration was given also to lessening the variations of tie-line loading. A departure from the fetish of frequency regulation is indicated. Heretofore, instead of being considered as a visible mark to serve as a guidepost toward better operation, it was regarded as the desired objective. Having succeeded in so regulating frequency that the chart evidenced a straight and narrow line, many were of the opinion that such things as load variations were a necessary evil. There were instances when the frequency of an interconnected group, approximating 3,000,000 kw. in combined load, was assigned to a station with 36,000 kw. capacity in operation. The regulation was manual. Experience had indicated on this interconnected group that a loss of generating capacity supplying 80,000 kw. would result in a momentary drop of two-tenths of a cycle until the governors responded and partially restored the frequency so that it was but one-tenth of a cycle low.

One logically asks, "how can the frequency regulation on this group be effected using but 36,000 kw. capacity?" To correct for but slight variations in speed, the magnitude of the swings on this station would be comparable in size to the capacity in operation. It is evident that the station was being penalized and the results accomplished were negligible.

Share system load variations

"Why not let the group as a whole absorb the variations?" was asked. All stations could be assigned a definite loading and they would permit this load to vary slightly as the governors of the units responded to variations. The load dispatchers would, as before, anticipate the load changes on their individual systems and instruct the operators at the stations when corrections in the load allocation were to be made.

This method would probably effect what was anticipated with the installation of automatic frequency control on each of the systems of the group. It would reduce the burden on one station and it would decrease the changes in the loading of tie lines. Failure of the load dispatcher properly to forecast his system load and instruct the stations to which a definite loading was assigned to make the necessary changes would, with either method, penalize some station or some system.

When this practice was first instituted the operator at the station to which the regulation had previously been assigned was instructed to watch the frequency and notify the load dispatcher if an error persisted. The operator was thus of aid in directing the attention of the dispatcher to load changes that were necessary.

Reproductions of the frequency and load charts for the station to which the regulation had previously been assigned are shown in Fig. 1. Of particular interest is the regulation during the noon period, when the load

is changing rapidly. It indicates the close attention directed to these changes by the dispatchers of all the systems operating in parallel.

Effects of failure to adjust loads

With automatic control, should one system fail to forecast accurately its load or be tardy in making changes in generation, the regulating stations will suffer by holding accurate instantaneous frequency. In following the method outlined, if one system is tardy in picking up or dropping load the other systems, in correcting for changes in their load, will adjust the load of the delinquent system to itself, but there will be a change in frequency. Should more than one system be tardy the frequency error will be greater. Word must then be passed along to all systems to correct at the same time. As the correction is in the same direction this can readily be accomplished.

Some may object to this frequency error even though it obtains for but a few minutes. But is there anything really objectionable in this? It is true that it must be corrected as soon as possible, to limit the error in frequency time.

Tie-line load variations can be reduced

If this method is practiced tie-line loading should be improved. Let us picture an interconnected group of systems the frequency of which is automatically regulated by a station at the end of the chain. The response of the controller to all variations in speed due to load changes is immediate. The changes in load on the tie between adjacent systems nearest the regulating station will probably be from one extreme to another. Even the closest possible attention to their load changes by each individual system will not insure the continuity of operation of a tie line so located if it is of relatively small capacity or the settings of the relays are low.

Should the regulating station be located in the middle of the chain tie-line loading variations would be considerably reduced in one direction. If this station regulated the frequency manually it is not certain that the swings on the tie line would be reduced. The rapid changes in tie-line loading when the frequency is automatically controlled permit no correction by an individual system unless the change is sustained. With manual regulation not only does the station correct for frequency error but has to make a further correction in the opposite direction when tie lines are adjusted by other systems. This game of seesaw may continue indefinitely.

To summarize, frequency regulation may be placed on all systems of an interconnected group by depending on the inertia of the tremendous capacities operating in parallel and the ready response of the governors of the great number of generating units supplying energy. This will eliminate the burden on a single regulating station. It will reduce the variations, now extreme at times, on tie lines between systems. It will permit as accurate time as at present furnished. As the frequency error will not normally exceed one-sixth of 1 per cent, the production of industrial customers will not be adversely affected.

To achieve the best results, it is essential that the operators and dispatchers of all the systems of an interconnected group have a true picture of the problem. Too often it has seemed that failure to secure the desired co-operation has been due to the lack of information on the part of operating men. It is important that they recognize the necessity of accurately forecasting their load, of anticipating the load changes and of immediately correcting for sustained load changes in their system load. Accurate performance along these lines will eliminate undesirable variations in the frequency. Frequency then will be considered the guidepost of load regulation.

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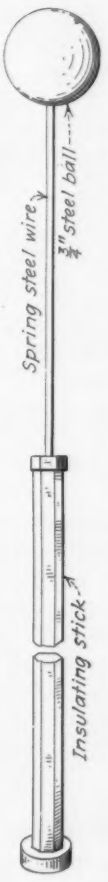
Tap Test for Insulators

By W. SHULER

Manager Electrical Division,
Dayton Power & Light Company, Dayton, Ohio



You can tell a good coin by the sound of it and you can tell a good insulator that way too. The electrical division of the Dayton Power & Light Company has proved this by finding nearly a hundred cracked insulator units in disconnecting switch, choke coil and other equipment assemblies in substation structures simply by tapping the insulators and listening to their sound. In the past improper methods for cementing cap-and-pin fittings to insulators have been used sometimes. Many such potentially defective assemblies are now in service. In the course of time the porcelain thus cemented has cracked and the cracks are frequently the precursors of electrical breakdown.

While discussing this matter with representatives of insulator and switch manufacturers, one salesman used a small metal ball to show the different sounds of perfect and cracked insulators. The suggestion to mount such a ball on the end of a flexible pole and to tap insulators in service to find cracked ones immediately presented itself. A ¾-in. steel ball was fixed to the end of a piece of spring wire, which in turn was secured to an insulating stick as shown herewith. The man selected to operate the device was given a short course in tapping so he could recognize the sound of a cracked insulator from the response of a perfect one. Then he was sent out to tap the top and bottom insulators in the switch, choke coil and other assemblies. So far, as said, about a hundred units have been found cracked in the bottom porcelain.

As yet, this testing stick has been used only on pin type insulating assemblies such as are commonly used for mounting disconnecting switches and choke coils. There appears to be no reason why the idea might not be adapted for use on all types of insulators, even on transmission lines. Sound porcelain should sound right no matter where it is.

Engineers Spared from Usual Duties

By J. S. SUTHERLAND
Manager Merchandise Sales Division, Alabama Power Company

Nature of duties and method of training.
Harmonizing sales cost with business acquired.
Smoothing out sales curve.
Where major attention is directed.
Co-operation with contractor-dealers.
Relative income of contractor-dealers and utilities from new installations.
Develop better appreciation of good illumination and better wiring and improve public relations.

PROCEEDING on the theory that a promotional rate would increase business, the Alabama Power Company offered a general rate reduction to its customers in January, 1930. The plans for recovering lost residential revenue by the further sale of electrical merchandise in the homes gave assurance that the revenue reduction from this class of customers could be rapidly built back, with both customers and company receiving benefit therefrom. The part of the plan to assist the commercial customer in realizing the full benefit of the rate meant a great deal of educational work.

With this idea in mind a lighting section, under the direction of the merchandise sales division, was organized. This section was composed of six men; two of these had previous experience in selling illumination, and the four others were from engineering and operating departments who had limited experience in the sales field but could readily be spared from their usual duties. The Edison Lamp Works of the General Electric Company and the Westinghouse Lamp Company collaborated in holding a lighting school for the members of the lighting section of this utility, and others in adjoining states were invited. The school lasted for one week and the work was carried on from early in the morning until late at night.

At the end of this period the men were assigned territories and the responsibility of developing commercial revenue for the company through the sale of additional lighting was definitely placed on them. These men were to act as consulting engineers, as no equipment or wiring was to be sold by them, but all loads added to the lines as a result of their activities were placed to their individual credit. Only the benefits of lighting were to be discussed, but they could make layouts and estimates for the prospect and further assist him in securing competent electrical installations. These six men have all displayed singular aptitude in retaining old business and securing new, and are still with the company and working in their original territory.

The men at first were put on a straight salary basis and assigned to territories containing from 4,000 to 5,000 commercial prospects per man. One man was retained at headquarters to head up activities, outline promotional and advertising activities, summarize reports from the field and render assistance to the field men whenever necessary. The field men were placed under operating executives in the field, but were expected to work in close touch with the headquarters office.

A comprehensive direct-mail plan of advertising was worked out, to be carried on during the year and to tie in with the usual activities of the lighting salesmen. Each lighting salesman was furnished with a copy of this set-up and several weeks before mailing was furnished with a copy of the material to be mailed. We have found this of great assistance in furthering lighting work.

As the activity was new we were unable at the outset definitely to set up quotas for the men to work to, but after the first 90 days such quotas were set up at headquarters and assigned to the field men. At the end of 1930 the five field men had added the following commercial lighting business to the lines of the company:

	Kw.
Additional business connected....	2,158
New business connected.....	1,176.8
Total business connected....,....	3,334.8

On the basis of the first year's activity the bogie for 1931 was set at 4,000 kw. in connected load, an equivalent of 0.19 kw. per customer. The revenue was estimated on the basis of 10 per cent incidental power, 30 per cent new business and 60 per cent additions to existing business. At the end of 1931 the records showed that the lighting section had made 115 per cent of its connected load quota and 105 per cent of its revenue quota. The load added amounted to 217 watts per commercial customer at an estimated load factor of 17.2 per cent.

The analysis of lighting sales for the first eighteen months of the lighting section's activity shows that the majority of sales came from the larger towns, although almost 50 per cent of the total number of commercial prospects were located in widely scattered small towns of less than 5,000 population. The analysis also shows that there was a discrepancy in the sales cost per kilowatt added due to differences in salaries paid to individual salesmen.

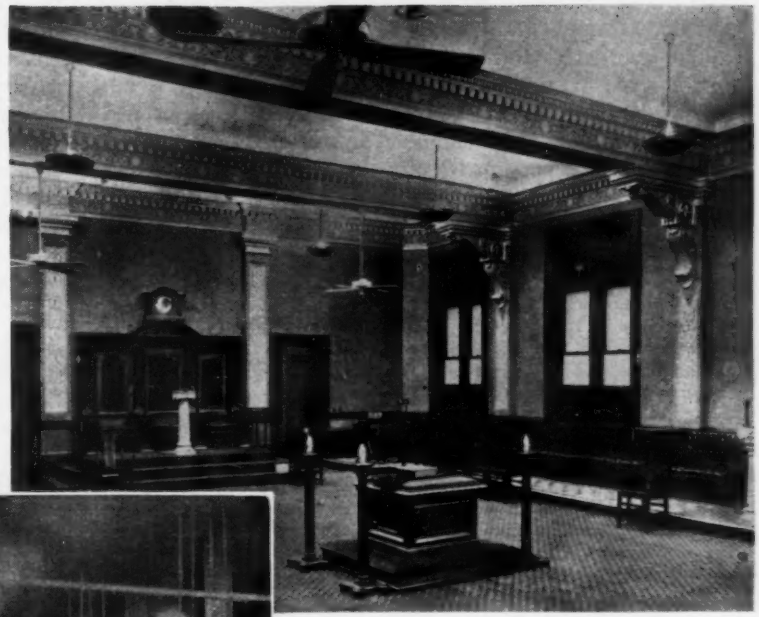
Bonus plan of compensation established

However, the results as shown by the analysis were so gratifying that four additional field men were added to the section in December, 1931, and a bonus plan of compensation was set up whereby all salesmen were paid the same salary. Against this salary was assigned a quota equivalent to 6 watts per customer per month for additional load and 3 watts per customer for new load. If the salesman exceeded his quota he received $2.50 bonus per kilowatt for each kilowatt added to an existing customer and $1 per kilowatt for new load. The quotas were made cumulative in order to obtain a more even sales curve.

The mechanics of the commission form of compensation are simple. The lighting salesman has the customer

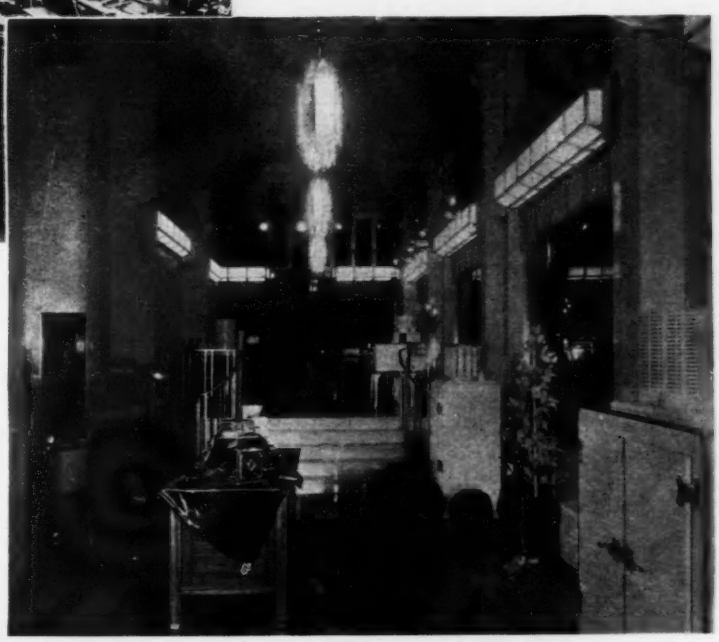
Develop Lighting Business

sign the company's standard form of application card for the load contracted and turns the application with his name affixed to the division auditor, who checks the contract with the meter



Some accomplishments

The quota for 1932 includes the following classes of business, which are arranged according to their anticipated contribution to new revenue: Store interiors; signs and outside display; miscellaneous; schools, public buildings and churches; show windows; industrial; residential; offices and theaters.



set order and posts the connected load to the credit of the lighting salesman on the form provided for that purpose. The commission form of compensation equalizes the cost per kilowatt added and is encouraging to the salesman, who has something definite to work to beyond his allotted task.

The budget for 1932 with nine field men was drawn on the basis of 6,463 kw. additional connected load, equivalent to 0.26 kw. per customer. Our sales for 1932 to date are only slightly be-

hind quota and this difference will be made up before the end of the year.

The quotas for the year 1932 are divided into the following classifications of business, based on the previous year's activities, and divided also into 10 per cent incidental power, 30 per cent new lighting load and 60 per cent addition to present lighting load:

Class of Lighting	Kw.	Per Cent of Total Kw.	Per Cent of Total Rev.
Signs and outside display	995.5	15.4	14.0
Show windows	277.4	4.3	6.0
Store interiors	2,784.3	43.2	56.7
Schools, public buildings and churches	543.4	8.3	6.3
Offices, theaters	110.6	1.7	2.1
Industrial	334.4	5.2	4.1
Residential	323.0	5.0	2.7
Miscellaneous	1,094.4	16.9	8.1
Total	6,463.0	100.0	100.0

As lighting equipment is not sold by the company but by the dealers in the various towns where we operate, lighting activities are equalized over the year rather than specialized as to different types of lighting by months. However, we have set up a schedule that we adhere to in general as follows:

Jan....Store windows
Feb....Commercial interiors
Mar....Sign and office lighting
April..Floodlighting
May..Public buildings
June..Street lighting
July...Theaters
Aug...Schools and churches
Sept...Industrial
Oct... Window lighting
Nov.. Commercial interiors
Dec...Residential and display

In cases where there are no dealers in small towns we occasionally sell lighting equipment as an aid to the prospect. A form for financing the entire wiring and equipment installed has been worked out, but it is found that contractor-dealers prefer to finance their own equipment sales. Records for 1931 showed the company financed less than $2,800 worth of equipment, although estimated revenue from lighting sales were many times this amount in annual revenue. In one division a record was kept to show the amount of installation cost as compared to annual revenue, and it was found that for every dollar in annual revenue anticipated by the company the contractor-dealer received $1.33 for material and labor.

Principal work of lighting engineers

It has been found that the principal work of the lighting engineer is in developing an appreciation of the value of good illumination and in insisting on correcting wiring and installations. It is felt that the prospect works more readily with the lighting salesman where no equipment is sold. When the lighting salesman attempts to sell equipment, it breaks down the customer's confidence and the recommendations may conflict with the recommendations of architects and contractor-dealers. It is fatal for a lighting section to merchandise equipment unless the company assumes the responsibility for the installation. Numerous cases of too small wire sizes, incorrect hanging and improper spacing of fixtures encountered in the course of our work point to the folly of the sale of equipment rather than the sale of illumination. By avoiding the sale of equipment and insisting on the correct lighting specifications, the lighting engineer obtains the confidence of the merchant or contractor, which results in a better job of illumination for the customer, increases business for the contractor, and increases revenue for the utility.

As a part of the educational program necessary, the utility has sponsored a number of commercial meetings at which are featured an illustrated lecture by a merchandising specialist on "modern merchandising methods." Every commercial prospect is invited to attend these meetings and lighting is brought out only as a factor of display. Further, we have found that the interest aroused by the meetings has resulted in a large percentage of prospects, who when solicited have been found to have some fundamental ideas of the value of properly lighted show windows and interiors.

The lighting section has conducted experiments in schools and other establishments that have aroused lighting consciousness and resulted in increased lighting loads. By close co-operation of the merchandise sales division signs, floodlights and other lighting media are sold. The service department works closely with the lighting salesmen, thus enabling the salesman to be familiar with the customer's reactions to lighting service problems.

Lighting salesmen not only add a splendid load to the lines of the company but do a very splendid work in improving public relations by explaining rates, service and policies to their commercial customers and by working closely with architects, electrical contractor-dealers and others interested in electric advertising.

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Microphone Extends Field of Conveyors

Conveniently spaced microphones along the lunch and refreshment counter of Loft's new 42d Street candy store, New York, supplemented by equally convenient electric dumbwaiters, have avoided the din of loud-voiced transfer of orders, eliminated the rushing back and forth of clerks and thereby reduced their tendency to perspire and become irritable, minimized the delay between reaching the counter and receiving the order and effected better utilization of space necessary for serving, preparing and storing products sold. As a result the clerks are able to take orders immediately when a customer approaches. Pressing a button beside the microphone and speaking in an undertone, the clerk is able to convey the order to the center of preparation and simultaneously indicate who requested it, so the order is delivered to the proper dumbwaited and labeled with its individual destination.

This innovation of the commercial application of microphones and electric conveyor should be sufficient to suggest many other applications which would be of benefit to the customer and vendor. Not only should most lunch counters consider it, but there is the possibility that it could be applied to average and high-class dining rooms. Information desks in offices announcing visitors might find the microphone more convenient than the telephone. Transportation stations could more extensively use the microphone and loudspeaker for announcing departure of trains, buses, etc., or the next stop, as is now done by some. Any vendor who requires considerable space to store or prepare the things sold could by the use of the microphone and electric conveyor utilize less valuable space for these purposes and still make the supply available to the customer without shouted orders, delay, rushing back and forth of clerks, etc. Extension of the idea depends on visualization of the economic possibilities.

Mechanical Design of Rural Lines

By E. V. SAYLES*
Commonwealth & Southern Corporation, Jackson, Mich.

Economy must lie in longer spans and in revision of ideas concerning factors of safety.
Variability of local conditions prevents dogmatism on unit costs.

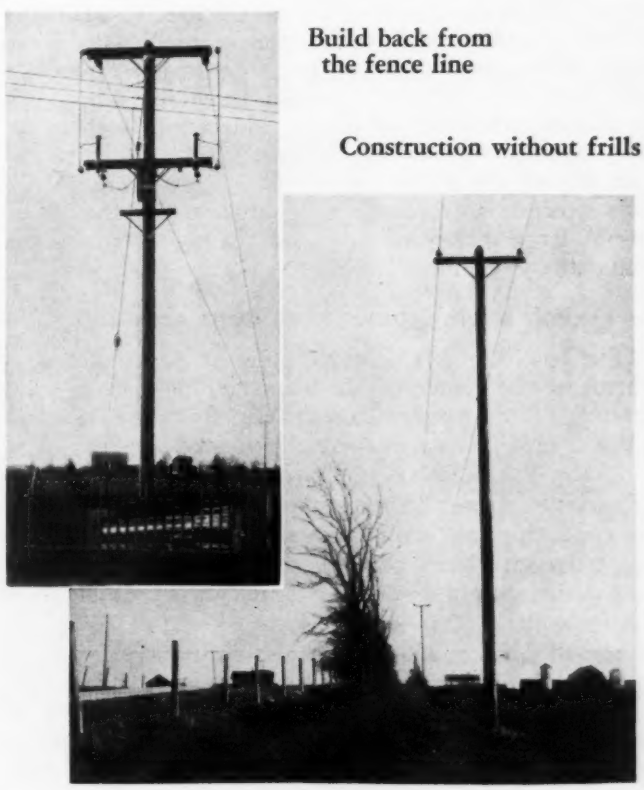
IN ORDER to satisfy the demand for cheap rural lines the designer finds that increased span length (fewer structures per mile) offers the greatest opportunity for reducing costs. Even though No. 6 copper conductor is entirely adequate as an electrical conductor for most rural lines, its mechanical strength is entirely too low to allow its use on longer span lines, say in excess of 175 to 200 ft., because it would require excessively high poles to maintain adequate ground clearances. The type of conductor needed for long span construction is one which has sufficient strength to permit its being strung to a tension which will limit the sag to 5 or 6 ft. after the conductor has been loaded and the temperature is at a maximum. Such a conductor is found in the aluminum cable reinforced with a steel core and also in a high-strength composite copper cable.

For the purpose of discussion, let us say that a rural line is to be built using a maximum span of 300 ft. and let us speculate as to the length and size of poles necessary for this line. We will assume that the line is to be built in the heavy-loading area, in which case the conductors would have a maximum loading of ½-in. thickness of ice and an 8-lb. wind.

The greatest force to which a pole is subjected is the force due to transverse loading, which occurs when the wind is blowing against the ice-covered conductors throughout the span length and produces a bending moment on the pole which tends to break it at or near the ground line. Fortunately, this force, or bending moment, is readily calculable. Various tables are available showing the wind pressure, or transverse loading, per foot on various size conductors for the heavy-loading area. A reference to these tables shows that this force amounts to about $\frac{8}{10}$ lb. per foot; in fact, for almost any common size line conductor this force does not exceed 1 lb. per foot. Assuming that No. 4 A.C.S.R. is used, the amount of pull exerted at the point of the crossarm support for a 300-ft. span will be some 240 lb. per conductor, or for three conductors (originally the line may be single phase, but may later be changed for three-phase operation) it would be 720 lb. A 35-ft. pole set 6 ft. in the ground with the crossarm supported near the top would have a moment arm of 28 ft., which with a 720-lb. pull at the top of the pole would amount to some 20,000 ft.-lb. Thanks to the new A.S.A. classification of wood poles, we can read directly from the tables the strength values in foot-pounds for any class pole. From these tables we can select a pole having a strength of 20,000 ft.-lb., which would be a class 7 pole rated 32,400 ft.-lb., or about 31,000 ft.-lb. after allowing for the wind loading on the pole itself, or, we may apply a "factor of safety" of two, which would give us 40,000 ft.-lb., corresponding approximately to a class 6 pole.

The new A.S.A. classification of poles makes the determination of the proper size of pole to use a relatively simple matter. However, in the application of this table there is one point which should be considered very carefully, and that is the "factor of safety" which has been applied heretofore when working with wood-pole structures having strengths not entirely known.

During the past years it has been customary practice among many companies to calculate the pole strength required and then apply a factor of safety all the way from one and one-half to two and one-half, this being justified on the basis that pole strengths were rather indeterminate, that a pole deteriorated greatly in strength over years of service, that assumptions were indefinite, etc. It would seem that the new A.S.A. classification has practically settled the matter of pole strength. The



Build back from the fence line

Construction without frills

*Adapted from paper to overhead systems committee, Great Lakes Division, N.E.L.A.

deterioration of pole strength over a number of years' use is something which has been practically eliminated by modern methods of wood preservation. The remaining factor, namely, the loading on a pole, or the pull at the pole top, is something adaptable to rather definite calculation.

Therefore, it would seem that the practice of applying large factors of safety in the selection of poles is one which is not entirely justified. As a matter of fact, in the calculation of poles strength factors of safety accumulated all along the line. For example, if the maximum span of a line is to be 300 ft. the pole strength is based on a 300-ft. span, whereas the average span will probably be more nearly 250 ft. Also, heavy loading is based on a 57-mile-per-hour gale, coincident with ½-in. ice on a conductor. While 57-mile-per-hour gales are not uncommon, yet it is seldom, if ever, that this velocity is reached at the same time a conductor is heavily coated with ice. Therefore, another factor of safety is introduced.

The minimum dimensions of poles under the new A.S.A. classification are based on fiber stresses of 7,400 lb. per square inch for creosoted Southern yellow pine, 5,600 lb. for Western red cedar, etc. I am not informed as to the closeness of these limits. However, it is reasonable to say that they are safe values, and perhaps include some leeway. The dimensions specified are minimum dimensions and there is no doubt but that poles furnished will ordinarily exceed these dimensions by small amounts, which, of course, adds a still further factor of safety to the maximum allowable fiber stress. Considering the above factors already present when the pole strength is calculated it would seem that the applying of large factors of safety to already safe values is not entirely justified.

Three Opportunities for Reducing Rural Line Costs

1. Build the rural line back from the tree line, or fence line, an appreciable distance so that no tree trimming is required and there is nothing to interfere with the uniform spacing of poles.

2. Reduce costs by reducing the number of structure per mile rather than by trying to reduce the cost of a typical structure by using various types of non-standard pole brackets, arms and attachments. Although a conductor of only small conductivity is ordinarily required, this conductor should have sufficiently high mechanical strength to permit the use of long spans. When high-strength conductor is installed be sure to make use of its high strength by lengthening spans.

3. Do not pyramid factors of safety.

Pole height depends on clearance necessary

The pole height is determined by the sag in the conductor at the center of the span and the clearance to ground. This assumes, of course, that there are no unusual obstructions in the right-of-way.

If No. 4 A.C.S.R. is used at a tension of 60 per cent of ultimate strength, the maximum sag at 60 deg. after the conductor has been loaded is slightly over 5 ft. With the crossarm placed close to the top of the pole, this will readily permit a ground clearance of something over 19 ft. with a 30-ft. pole, which is entirely adequate. Spans of 325 or 350 ft. can also be used with corresponding increases in sag of approximately 1 ft. and 2 ft. If it is deemed necessary to maintain a clearance to ground of 19 ft., it is evident that 300 ft. is about the maximum span which can be used with No. 4 A.C.S.R. and 30-ft. poles, but if ground clearances of 18 or 17 ft. are found to be adequate, then the longer spans can be used.

No. 2 A.C.S.R. offers certain advantages in the way of increased span lengths. It can be strung at a higher tension with correspondingly less sag, so that span lengths of 350 to 400 ft. should give less sag than No. 4 A.C.S.R. at 300 ft. If spans in excess of these values are used with No. 2 A.C.S.R., it is advisable to use a 35-ft. pole if proper ground clearances are maintained.

The use of 30-ft. poles with 300-ft. maximum spans and No. 4 A.C.S.R. seems to be a fairly economical arrangement. The use of longer spans with No. 4 A.C.S.R. means the use of 35-ft. poles or else the use of the next larger conductor size, No. 2 A.C.S.R. Also, the combination of No. 2 A.C.S.R. and 35-ft. poles will permit spans much in excess of 350 ft. These facts clearly indicate that the proper combination of these conductor sizes, spans and pole heights can be determined only by a comparison of costs, inasmuch as rural lines can be built using these various combinations which are entirely satisfactory.

Crossarms, Pins, etc.—With spans of the order of 300 ft., our experience has been that a standard four-pin (5-ft. 7-in.) crossarm is entirely adequate from the standpoint of conductor separation. With spans of 350 ft. or greater, it seems advisable to use a six-pin (8-ft.) arm to provide greater clearance. The remaining materials which go to make up a rural line offer little possibility of discussion. It is, of course, possible to use either steel or wood pins, the steel pins being preferable from the standpoint of mechanical strength, although somewhat more costly than wood pins. The steel pin, however, does not require as large a boring through the crossarm as does the wood pin, and consequently retains greater strength in the arm.

Secondary Construction—Secondary construction represents somewhat of a problem when it is necessary to construct any considerable amount of it using the same poles as the rural primary. In general, our experience has been that for strictly rural lines very little secondary construction is required, especially on the lower primary voltages where the cost of a small transformer installation can be made to approximately the cost of three or four spans of secondary when the extra pole height and possible extra pole strength are taken into account.

With spans of 300 ft. or greater, it is obvious that the use of No. 6 copper is impossible. No. 4 copper can be used, especially if used with standard distribution crossarms, in which case bare conductor would be suitable. No. 4 A.C.S.R. also offers certain advantages for secondary use, its construction being identical with the

primary line (excepting insulation). No. 6 copper, triple braid, weatherproof, can readily be used if an intermediate pole is set to shorten the span to 150 or 175 ft., in which case vertical rack construction would be suitable.

Choice of these types of construction will depend almost entirely upon their cost, although there is a slight difference between the voltage drop experienced. The No. 4 A.C.S.R., having the wide spacing, will have the greatest voltage drop, No. 6 copper secondary slightly less and No. 4 copper secondary, with wide spacing, still less. The approximate volts drop per kva. per 100 circuit-feet are 0.4, 0.37 and 0.27 respectively. The use of bare secondaries on crossarms is sometimes rather objectionable from the standpoint of tree clearances. In many cases the use of this type of construction would require excessive tree trimming, whereas in the case of covered conductor on vertical racks the secondaries can be worked through trees without great difficulty and a minimum amount of trimming.

A comparison made covering the cost of 600 ft. of three-wire circuit built on poles of a 300-ft. span primary line showed the use of No. 4 A.C.S.R. to be slightly cheaper than the other two types of construction. Based on its cost as being 100 per cent, the cost of No. 4 copper with wide spacing was 120 per cent and the cost of No. 6 triple-braid, weatherproof secondary, using an intermediate pole to shorten the span, was 130 per cent.

Comparative costs of rural lines

The comparative costs of a mile of typical rural line, as built by various companies, are most difficult to determine. The comparative costs of a mile of different types of construction as built by one particular company are relatively easy to determine, only, however, if the construction estimates, or cost analyses, cover lines built by one construction organization in the same area.

If the cost of a rural line comprised only material and labor, the comparison of types of construction as built by different companies would be a relatively simple matter. However, we all know that such is not the case. We have all seen, during the past few years, a great many articles dealing with the cost of rural construction, one article pointing to a cost of $1,000 per mile as being a most commendable achievement, while another points to a cost of $500 or less a mile as being a suitable type of construction. After having analyzed several of these cost comparisons, there is little doubt in my mind that the figures usually given are not at all on a comparable basis. Many of these stated costs per mile are so far apart as to include in one case the line, transformers, secondaries, services, meters, etc., while in another case only the bare cost of a single-phase primary line is included. The total investment per mile will obviously vary greatly with the number of customers per mile, and if the density for various areas is nearly the same, we might compare costs of rural service on a "per customer" basis.

Unless all items, however small, entering into the cost of rural line construction are included, there is no merit to the publication of cost data. In other words, all factors must be included or accounted for. Some of the factors entering into the cost of a line which are sometimes not taken into account are as follows:

Costs sometimes overlooked

Cost of solicitation and commercial or sales department cost for negotiating contracts and special adjustments due to conditions for connecting to existing financed lines, etc.

Cost of obtaining right-of-way from property owners, permits from county or state highway authorities, notarial fees and cost of recording easements at courthouse.

Cost of obtaining tree trimming permission and actual labor of trimming and brush removal.

Cost of surveying and staking (may be considerable on unimproved road of indeterminate width and lacking monuments).

Cost of engineering, including preparation of preliminary and final detail drawings for contracts, railroad crossing agreements, telephone co-ordination, etc.

Cost of checking construction after completion, numbering poles and revising operating maps.

Cost of freight, cartage, stores department handling, warehousing, etc.

Cost of lightning arresters, grounds or sectionalizing cutouts.

Cost of transformers and transformer installation costs.

Cost of lines on private property back from main road.

Cost of service connection wires, entrance conduit, entrance switch, meters.

Cost of Underwriters' and company service entrance inspection.

Percentage for "injuries and damages."

Percentage for local accounting, construction supervision, management or whatever terms the particular company may use for these costs.

Percentage overhead on construction for finance and interest during construction, etc.

Percentage allowed for contingencies, labor and material, if estimated.

In the study of long versus short spans, using the minimum conductor size, rather careful cost estimates were prepared which showed that the cost of long-span construction was approximately 78 per cent of the cost of short-span construction. Although these costs are fairly accurate for the particular territory in which they were considered, they may vary rather widely in different parts of the country. However, the costs did show rather conclusively that long-span construction with high-strength conductor is very definitely cheaper than short-span construction. As a matter of fact, it is doubtful if this actually needed any proof, inasmuch as it has been demonstrated so repeatedly in the last few years that long spans are in use by the majority of power companies building rural lines.

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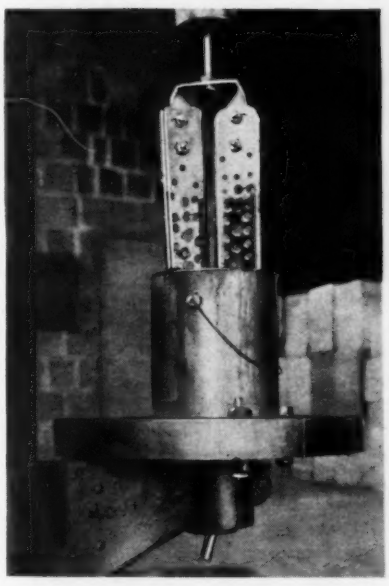
Economy in the Transformer Shop



Power paddle insures quality of transformer paint job

Well-stirred paint is one of the cardinal requirements of a good paint job on a reconditioned transformer. Stirring is a slow, tedious job and because of this is often neglected. The useful life of the applied paint is shortened by insufficient stirring and the labor cost of application is the same. Since the labor cost is a large portion of the total costs it is essential, in order to secure maximum useful life, to have

the paint properly conditioned before applying. This is especially true in the case of red lead paint, which forms the undercoating in common use. Due to its weight considerable stirring is required properly to suspend this pigment in the vehicle used.

The transformer shop of the Toledo Edison Company uses a simple and effective means of meeting this requirement. A double metallic paddle is inserted in the chuck of a power-driven drill press. The drill press is operated at low speed. Large or small quantities of paint are mixed perfectly in this manner at very little expense with no physical effort, which in turn has eliminated the necessity of checking paint for adequate stirring. The cost of this device is less than $1.

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To Avoid Confusion in Selecting Color Media

By A. L. POWELL
Manager Eastern Office
General Electric Company,
Nela Park Engineering Department

There is probably no field in lighting where more confusion exists than in the names and other designations applied to glass, gelatin and other selectively absorbing media. Sometimes names are applied to the material, such as red, light blue, medium amber, deep pink, etc. Yet what may be termed orange, for example, by one manufacturer may be very radically different from the filter called orange by some other supplier. Conversely, one identical color may be known as rose purple, heliotrope, magenta, dark lavender, etc. No uniformity exists in the question of shades and tints. The same screen may be called light green, medium green, dark green, in different listings.

With the gelatins used for stage lighting, it is common practice to designate these by number, and if one makes a comparison of different sample books he will find that a given color is designated 23, 63, 38, 26, 22, 15 and E-31. A similar situation holds with glass roundels, although it is not quite as complex because they are available in a much fewer number of colors.

The Inter-Society Color Council, which is composed of representatives of various organizations interested in color, such as the Textile Color Card Association, the Illuminating Engineering Society and the Optical Society of America, has the matter under consideration at the present time, and it is hoped that it may be possible to work out a standardized system which will include all color material used in the theater, such as glass, gelatin, pigments, fabrics, etc. The accompanying schedule has been suggested as something on which to base this standardization. This has already been adopted by a number of the suppliers of colored gelatin. It is not claimed that this is perfect or represents the ultimate in this classification. There is probably a finer gradation than is required from practical considerations, but the list is made complete to include all tints and shades that have been usd in service. It makes very little difference what particular numbering system is applied provided the same color is always given the same numerical designation. In the proposed tabulation the colors are arranged spectrally and darker shades follow the light tints in each basic color.

Suggested Basis for Standardizing Color Terminology

1 — Frost	25 — Daylite blue	49 — Dark green
2 — Light flesh pink	26 — Light slate blue	50 — Light lemon
3 — Flesh pink	27 — Light blue	51 — Medium lemon
4 — Medium pink	28 — Light navy blue	52 — Dark lemon
5 — Pink	29 — Special steel blue	53 — Very light straw
6 — Rose pink	30 — Light blue special	54 — Light straw
7 — Dark rose pink	31 — Medium sky blue	55 — Medium straw
8 — Deep pink	32 — Medium blue special	56 — Dark straw
9 — DuBarry pink	33 — Medium blue	57 — Light amber
10 — Light magenta	34 — Medium navy blue	58 — Medium amber
11 — Medium magenta	35 — Dark sky blue	59 — Amber
12 — Dark magenta	36 — Non-fade blue	60 — Dark amber
13 — Rose	37 — Dark blue	61 — Orange
14 — Rose purple	38 — Dark navy blue	62 — Light scarlet
15 — Dark rose purple	39 — Urban blue	63 — Special light red
16 — Violet	40 — Light green blue	64 — Light red
17 — Special lavender	41 — Moonlight blue	65 — Medium scarlet
18 — Medium lavender	42 — Nile blue	66 — Pink red
19 — Dark lavender	43 — Light blue green	67 — Fire red
20 — Light purple	44 — Medium blue green	68 — Pure red
21 — Purple	45 — Blue green	69 — Special chocolate
22 — Royal purple	46 — Dark blue green	70 — Chocolate
23 — Medium purple	47 — Light green	75 — Neutral gray
24 — Dark purple	48 — Medium green	

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READERS' FORUM

Electric Shovel Excavation Costs 4 Cents per Cu.Yd.

To the Editor of the ELECTRICAL WORLD:

It has been brought to our attention that the figure of 6 cents per cubic yard excavating cost for the Hoover Dam shovels (ELECTRICAL WORLD, August 13, page 201) is incorrect. We have just received the following figures from the Six Companies, Inc., builder of the Hoover Dam: The operating cost (wages, shovel crew) is $25 per eight-hour shift. Electrical and machinery maintenance cost (wages, crew) is $6.22 per eight-hour shift. (This represents one-ninth of the cost of a roving crew which attends to nine shovels.)

Power consumption was at the rate of 0.3 kw. per cubic yard excavated. The cost of power was estimated at that time to be at the rate of $0.018 per kilowatt-hour, making the power consumption $0.0054 per cubic yard. The work is carried on during a 24-hour day, or three eight-hour shifts. One-hundred and twenty cubic yards is a fair average for excavation for the hours which the shovels work. This makes a total of 960 cu.yd. per eight-hour shift.

The cost per cubic yard may be shown as follows:

Operating cost	$= \frac{25}{960} =$	$0.026
Power cost	=	0.0054
Maintenance cost	$= \frac{6.22}{960} =$	0.0065
Cost per cubic yard for excavation		$0.0379

We received the previous figure of 6 cents from our representative, but it seems that it was the result of an incorrect interpretation of the figures.

W. P. ALBRECHT.
Westinghouse Electric & Manufacturing Company.

Men of the Industry

H. E. Dexter Assigned to Broader Duties

Harris E. Dexter, for the past five years assistant general commercial manager of the Central Hudson Gas & Electric Corporation, Poughkeepsie, N. Y., has been appointed general commercial manager by the corporation's newly elected president, Ernest R. Acker. Mr. Dexter is in a large measure responsible for Central Hudson's successful transition from a utility doing aggressive merchandising through the stages of dealer co-operation to being the recipient in 1931 of the James H. McGraw award for co-operation. He has been engaged in various phases of the electrical industry here and in the Far East since his graduation from Massachusetts Institute of Technology in 1912. On leaving college, he was associated with the General Electric Company until the outbreak of the World War.

Following the war he embarked for China, working with the International General Electric Company's agents there. Owing to the chaotic conditions in that country he returned to America, where he served as chief of the electrical equipment division, United States Department of Commerce, for a brief period. He became associated with the Central Hudson Gas & Electric Corporation as merchandising manager in 1927. He has been active in the National Electric Light Association, having been a member of the merchandising bureau and rural service committee and chairman for the past two years of the farm equipment committee. He is also a member of the American Institute of Electrical Engineers, American Society of Mechanical Engineers and the American Gas Association.

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SARA HARRIS, formerly assistant secretary of the Utica Gas & Electric Company, Utica, N. Y., was appointed secretary of that organization at a recent meeting of the board of directors.

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L. A. GRAHAM has been appointed sales manger of the Falk Corporation, Milwaukee, for all commercial products of the company. Mr. Graham has had wide experience in the selling and promotion of technical products. Recently he has been engaged in consulting sales work for the Falk Corporation and other engineering manufacturers in the Milwaukee district.

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Dr. FRIEDERICH VON SIEMENS, youngest son of the founder of the Siemens organization, Werner von Siemens, celebrated his sixtieth birthday September 5. Dr. von Siemens is the active head of the Siemens family, as well as of all the Siemens enterprises, comprising important electrical manufacturing companies. He has been chairman of Siemens & Halske A. G. and Siemens-Schuckertwerke A. G. since 1919.

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COLONEL HUGH L. COOPER has been awarded the Order of the Red Star, the Soviet Union's highest decoration, for design and construction of Dnieprostroy, world's largest hydro-electric plant, building of which began in 1927. Colonel Cooper is the first foreigner to receive this decoration, which is awarded only for "outstanding achievements in defense of the country."

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OBITUARY

Dr. MAX JÜLLIG, for many years head of the Vienna Technical High School and one of the pioneers of electricity and electrical engineering in Austria, died recently in Vienna at the age of 78.

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J. L. VAN DOREN, who in 1888 established the electric light system for the village of Phoenix, N. Y., died at his home in Ilion, N. Y., early this month. Mr. Van Doren also founded and built the water supply system for the same community.

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RICHARD J. SMITH, chief engineer of the Malden (Mass.) Electric Company since 1901, died suddenly at Malden August 22. Mr. Smith was born in Ireland in 1865 and prior to his service with the utility company spent many years at sea as a marine engineer. For ten years he was in the marine engineering service of the Brazilian government. During the World War he was loaned to the United States government by the Malden company and officiated as an inspector of marine machinery at Hampton Roads, Va. Since the closing of the Malden company's steam plant as a reserve station a few years ago, Mr. Smith had been in charge of building maintenance work on this property and the affiliated Malden Gas Light Company.

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OLIVER C. SEMPLE, formerly a member of the Public Service Commission of the State of New York, died August 27 at Bradford, Vt., where he was spending a vacation. He was 71 years of age. Mr. Semple is credited with framing much of the public service legislation in New York State in the past fifteen years. Following graduation from Amherst College be studied and practiced law in Minneapolis and New York. He served as assistant counsel to the Public Service Commission for the first district of New York before his appointment as a member of the Public Service Commission by Gov. Nathan Miller. Mr. Semple retired some few years ago.

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NICHOLAS ROMMELFOUGER, long identified with electric vehicle activities in eastern Massachusetts, an authority of note upon storage battery engineering and a designer of gasoline-electric motor cars, died at Boston August 14 after a long illness. He was born at Trier, Germany, 63 years ago and came to America in 1894.

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HORACE M. HARRIMAN, an electrical engineer with Ford, Bacon & Davis of New York, died August 28 at his home in Rahway, N. J., after a short illness. Mr. Harriman was born in Baltimore and received the degree of bachelor of science in electrical engineering from Johns Hopkins University. He was 56 years of age.

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ROBERT O. QUICK, director of public relations for the Wisconsin Power & Light Company, died at his home in Madison July 24 after a long illness. Mr. Quick was widely acquainted, through his N.E.L.A. and other association activities, in the Great Lakes area. He was chairman of the Wisconsin Utilities Association public speaking committee for several years and in that capacity arranged the several state employees' speaking contests sponsored by N.E.L.A. and the state association.

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WALTER KEITH BROWNELL of United Engineers & Constructors, Inc., died, of pneumonia, at his home in St. David's, near Philadelphia, Pa., at the age of 44. Mr. Brownell was born in Brookline, Mass., and received his technical training at the Massachusetts Institute of Technology. He was at various times associated with Stone & Webster Engineering Corporation, the American International Shipbuilding Corporation and Dwight P. Robinson & Company, Inc. In 1928, when United Engineers & Constructors, Inc., was formed Mr. Brownell continued as chief of the structural engineering division with the new company, the duty which he held with the predecessor corporation. In 1929 he was assigned as structural engineer on the Philadelphia improvements of the Pennsylvania Railroad. Mr. Brownell was active in engineering circles, a member of the American Society of Civil Engineers, the American Society for Testing Materials and the American Railway Engineering Association.

New Equipment Available

Non-Resonant Potential Transformer Announced

A non-resonant potential device which makes it possible economically to use a carrier-current coupling capacitor as a source of potential for certain instruments and relays is announced by the General Electric Company. The device, designated as type KA-111, consists of a specially designed transformer to be used in series with the carrier-current coupling capacitor. The transformer is shunted by a gap to limit the voltage and is equipped with a grounding switch which is used when adjustments are being made.

A maximum output of approximately 100 watts is usually available with the device. However, because of the non-resonant design, the phase angle between the line-to-neutral voltage and the load voltage must be about 90 deg. to secure the maximum watt output. An auxiliary burden and the five taps on the transformer secondary are used to adjust the device to the proper voltage and phase angle. The device may be used for voltage and directional and distance relays of the impedance type.

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A SMALL SIZE CRANE LIMIT SAFETY STOP with standard mill type blowouts and contact tips is announced by Cutler-Hammer, Inc., Milwaukee, Wis. These stops are used to prevent overtravel of the hoist on electric cranes and are rated for 40 hp. and under.

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GALVANOMETER SUSPENSION UNITS designed to provide a stable means of support for instruments of the suspended mirror type for all kinds of measurements is announced by the G-M Laboratories, Inc., Chicago. It is designed to facilitate rapid assembly and with convenient adjustment to accommodate instruments of different sizes.

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SEMI-INDIRECT SOCKET suspension lighting units, known as "Ivoryglow," are announced by the F. W. Wakefield Brass Company, Vermilion, Ohio. A new urea-formaldehyde molding compound is utilized in forming a lighting reflector, which produces a unit light in weight, non-shatterable and impervious to moisture.

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SYNCHRONOUS MOTOR STARTERS entirely inclosed in cubicles for protection against dust are announced by the Westinghouse Electric & Manufacturing Company. In them are three compartments; one contains an incoming line circuit breaker with disconnect switches, while each of the others houses an individual synchronous motor starter with an electrically operated breaker and an individual disconnect switch.

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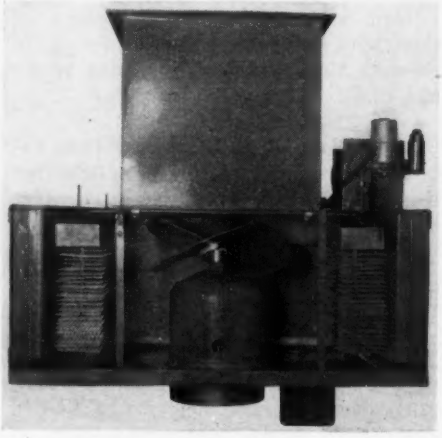
Air Filtered and Humidified by Central System for Home

A device which will circulate, filter and properly humidify air in a home without the use of a duct system, known as "Humifilter," is announced by the General Electric Company. It is capable of producing a complete change of air in the lower part of a house in 40 minutes, or about one and one-half changes per hour, it is claimed.

The "Humifilter" has been shown through tests to be effective in humidifying the entire home, since the diffusion and distribution of moisture in



the air in a closed space is not dependent upon the movement of the air within the space. The device has an evaporating capacity which will supply an adequate amount of moisture to homes with a volume not exceeding 50,000 cu.ft. It is installed in the first floor of a home and discharges a gentle flow of air through the floor grille. This air is taken from the basement and passed through a filter which removes dust suspended in the air. It then passes through a humidifier, which makes use of hot water to facilitate evaporation. The water is heated by a small amount of steam supplied by the existing boiler. Cleaned and humidified, the air then passes through the discharge grille. Circulation is produced by a quiet, elastically mounted fan driven by a small motor. The air is brought back to the basement through a return grille at the far side of the house.

Indoor Oil-Filled Potential Transformers

New line indoor, oil-filled potential transformers, designated type PO, rated 200 volt-ampere capacity, suitable for accurate metering service or for tripping or relay voltage supply, are announced by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. They are available for 6,900, 11,500 and 13,800-volt service, 60 or 25 cycles.

Some of the features of this line are high safety factor in insulation strength in the primary winding, liberal-sized primary porcelain, internal parts cover suspended, facilitating inspection, and fixed secondary terminals inclosed in conduit terminal compartment.

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All-Motor, Integral and Flexible Type "Motoreducers"

Gear reduction units of several types known as the Falk "Motoreducer" are announced by the Falk Corporation, Milwakee, Wis. These devices permit the assembly of the motor and reducers on a single base. The all-motor type is carried in an extension of the reducer housing, thus providing a unit of the utmost rigidity and providing an integral mounting for two separate units, simplifying alignment problems. The elimination of joints and the combination of-cylindrical and parabolic curves makes this unit unusual and very pleasing in appearance. A Falk resilient coupling joins the standard motor shaft with the pinion shaft, not only guarding against misalignment of any kind but affording torsional flexibility to the drive. The pinion is carried in two generous-size ball bearings, without overhand.

In the integral type a motor with a standard round frame is used. The end bell is removed and the motor close-coupled to the reducer through a mounting ring adapter with bayonet type joint. Ease of maintenance is a feature of this type. Either the motor or the gears may be easily removed for inspection or maintenance without disturbing the other or the main housing alignment. The integral construction makes for extreme compactness and simplicity.

The flexible type embodies essential design features of the integral type and allows the use of the vertical type round frame motor without change of any kind. The bayonet type adapter is bolted to the end bell and centered on the machined annular ring which the motor manufacturer provides for that purpose. The distinctive feature of this type is that it provides for the use of a motor which retains all of its standard parts as originally incorporated into it by the motor manufacturer.